# SEA-MANS PRACTICE

Containing

A FVNDAMENTAL PROBLEME in Navigation,

Experimentally verified:

Namely,

Touching the Compasse of the Earth and Sea, and the quantity of a Degree in our *English* measure.

*ALSO,*

An exact method or form of keeping a Reckoning at Sea, in any kinde or manner of Sailing.

With certain Tables and other Rules useful in *Navigation. As also in the Plotting and Surveying of places.*

The Latitude of the principal places in ENGLAND.

*The finding of Currents at Sea, and what allowance is to be given in respect of them.*

The Fourth Edition.

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By *Richard Norwood*, Reader of the *MATHEMATICKS.*

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*LONDON,*

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# To the Right Honourable
# ROBERT,
## Earl of *WARWICK*, Baron of *LEES*, &c.

Right Honourable:

*ALthough the knowledge and practice of the Art of Navigation be of late years grown to a far greater Perfection, then it can appear to have had in any former Age, and by that means, the World and all the parts thereof have been further discovered, yea, Sailed round about: the Traffick and Entercourse of several Nations, how remote soever, facilitated. Knowledge in divine and humane things divulged: and (which as I conceive is of most importance, seeming as yet to be the principal scope of the Divine Providence in discovering these Mysteries) the light of the glorious Gospel of* Christ, *being the mighty power of God unto salvation, is extended to those silly Captives of Sathan in* America, *by*

means of those many Plantations we have amongst them: which Plantations, (even from their first breathing) have received no small furtherance from your Noble favour & bounty, as I know by my own Experience in that where sometimes I was, and have understood no lesse by others in the rest.

Yet notwithstanding this notable growth and daily exercise of the Art of Navigation, it still remains imperfect in some points. For whereas the practice thereof doth especially consist in the knowledge of Latitudes, Courses, and Distances; the way of finding distances at Sea, namely, by the Log and Line, is rather opinionative and conjectural then certain, being grounded upon this supposition, that the compasse of the World in any great Circle is 21600 Italian miles (as they call them) and that such an Italian mile contains 1000 Paces, and every of those paces five English feet: and according to these measures they divide their Log-line, and keep their account of the ships way at Sea.

Having therefore by an Experiment which I made a year since, found more neerly the compasse of the Earth, and the quantity of a Degree on the same in our known measures, and applyed it to use in Navigation, in this Treatise following: and further added some other things as I conceived to be wanting in the practice of that Art: I have presumed to present it to your Lordship, aswel because by your knowledge in Navigation, and the experience you have had in your Honourable enterprizes at Sea, you are well able to judge of it: as also being confident that according to your noble disposition you will favourably accept thereof, though otherwise of it self unworthy. The most High God ever blessed and glorious, multiply unto your Honour all his blessings in Christ Jesus.

Your Honours in all due Observance,

Richard Norwood.

# To the Reader.

THe Circuit of the Earth and Sea (as the circumference of every Circle) contains 360 Degrees, by which degrees the distances thereon are measured, so that the knowledge of the quantity of such a Degree in our known measures, is a fundamental principle in Cosmography and Navigation, as upon which is grounded the reckoning of the ships way or distance run. For though a Mariner being in his Voyage on the vast Ocean, have sometimes three things to certifie him where he is, and how to shape his Course to his desired Port, namely, his Latitude, Course and Distance, and sometimes a fourth; namely, some neer conjecture of his Longitude by the Variation, or otherwise; yet oftentimes (as in close weather) he hath nothing but his course and distance; otherwhiles, onely his Latitude and Distance is his chief guide in sailing with his intended Port. I know it is usual to allow neer 7 Fathams 40 2/3 feet to a knot, and so many of those knots as runne out in half a Minute, so many miles they account the ships way to be in an hour. And if in half a minute she run 41 2/3 feet, then in 60 minutes or an hour she runnes 5000 Feet, and thus they account 5000 English feet, or 1000 paces to be a mile, and 60 of those miles to be a Degree, such as the whole circumference in any great Circle is 360. But how is this known to be true? If it be answered, that it is known to be so by Experience, then I would know further by what experiment this was found to be so? Where, and by whom made? I press this so much the rather, because I am perswaded we have at this day as many excellent Navigators in this Kingdome, and as great Voyages performed, as from any other place in the World, and I should be glad to hear of the experimental resolution of this *Probleme* by some of them, though it were but in running eight or 10 degrees neer the Meridian: for so I doubt not but that which I have here written thereof would receive further confirmation and better entertainment then haply it will now, being so much different from the common opinion, and the Arts of Navigation & Cosmography would be much more perfected in short time. For one errour (as a fruitful mother) is oftentimes the cause of more, and so the removing of one is the occasion of removing others, especially, when they do mutually support one another: As we shall here shew how the Errour in the Projection and use of the Common Sea-chart, is supported by this Errour of accounting onely 300000 of our Feet to a Degree; & this in like sort upheld by that, so that they will stand or fall together. And surely that had fallen long since, being so manifestly convinced; if it had not been upheld by this: For the confuting of that, (I mean the common Sea-chart)

it was ſufficient to know that the Earth and Sea make one Spherical body, but in diſproving & rectifying this, it is neceſſary to know moreover what is the quantity of that Spherical body: and to that end it was neceſſary to make a ſenſible application of our known Meaſures, to a determined part of the whole, that ſo the quantity of that determined part being known, and the proportion thereof to the whole, the quantity of the whole might alſo be diſcovered. And this I have indeavoured in the experiment following, which if I have not handled ſo exactly in all points as ſome would deſire: That requiring more time and charge (then I could well beſtow) yet I doubt not but it will be found that I have come very neer the Truth. Some haply will cenſure me, for being my ſelf at the Expence to make ſuch an Experiment. But I was as frugal in it as I could, adding pains and induſtry to ſave expence, I came up in ten or eleven dayes, and had other neceſſary occaſions to lead me from the one place to the other, and did this as a thing falling opportunely in my way. But indeed (as in all other parts of Learning) ſo in the Mathematicks, eſpecially in their application, or middle Mathematicks (as ſome call them,) it is neceſſary with Speculation to joyn Actual and Experimental practices; the former being empty & uncertain without theſe. It is true, that the Mathematicks afford large fields of delightful Speculations, wherein a man might walk far with much pleaſure: But if from ſo many fair Flowers he bring home no honey, or from ſuch large fields no ſheaves: I meane, if he bring not thoſe Speculations to ſome uſeful practices, neither himſelf nor others are like to receive much fruit by them. But this indeed cannot be effected without more labour and difficulty, yea ſometimes it requires Mechanical and Bodily exerciſes, which ſome eſteem too mean and unworthy to ſtoop unto. But for mine own part, I acknowledge to have had my living and maintenance by the Mathematicks, and not by Speculation only, but rather by my practice therein; and therefore alſo I deſire (what in me lies) to make them fruitful to my ſelf and others: And to that end have ſpent in ſome principal parts of the Mathematicks, neer as much time and means in experimental Practices and Concluſions, as in the Speculation. Moreover, conſidering that this particular Experiment was propoſed above thirty years ſince, by our Countrey-man *Mr. Edward Wright*, to invite ſome to the trial of it, as a thing which he would have done himſelf, if he had found ſuch furtherance and opportunity as he deſired, which it ſeems he did not, nor any other ſince that time: Rather then ſo noble and ſo neceſſary a *Probleme* ſhould longer reſt unreſolved, I took the opportunity offered, hoping it may be an occaſion to wher on ſome others to do the like. This with ſome other things which I conceived to be wanting in the practice of Navigation, I have handled in this enſuing Treatiſe, which I commend to your friendly acceptance, Farewell.

*July the firſt*, 1636.

THE

# THE SEA-MANS PRACTICE.

## CHAP. I.

*The common Opinion touching the Compaſſe of the Earth, and quantity of a Degree of the ſame.*

IT is a common received opinion in *England*, (and the like is in other places) that allowing 5 of our *Engliſh* feet to a Geometrical pace, 1000 of thoſe Paces make an *Italian* mile, and 60 of thoſe miles in any great Circle upon the Spherical ſurface of the Earth or Sea make a Degree; and thus it is ſuppoſed, that a Degree contains 60 miles, or 60000 paces, or 300000 of our *Engliſh* feet, and by ſuch miles do Mariners in their Voyages by Sea keep their Reckonings: And becauſe the whole circumference of a Circle is 360 Degrees; therefore the compaſſe of the Earth, according to this opinion ſhould be 21600 ſuch *Italian* miles, or 21600000 paces, or 108000000 of our *Engliſh* feet. Whence this opinion came, or upon what experiment it ſhould be grounded, I cannot certainly ſay; It may ſeem to be taken, or rather miſtaken

miſtaken from *Ptolomy*, who ſaith, there are 500 *Stadiums* in a degree, the ſame was before affirmed by *Marinus Tyrius*, of whom *Ptolomy* ſpeaking in the 11. Chapter of his Book of *Geography* hath theſe words, *Sed in hoc quoq; recte ſentit partem unum qualium eſt circulus maximus tricentorum ſexaginta, quingenta in terra conſtituere Stadia, id enim confeſſis dimenſionibus conſonum exiſtit.* Now a *Stadium* not onely amongſt the *Greeks*, but as appears by *Herodotus*, amongſt all other Nations of *Aſia* and in *Egypt*, did conſiſt of 600 feet, or 100 *Orgyas*, an *Orgya* conteining ſix feet or four cubits as our fatham doth: the ſame is alſo teſtified by *Suidas* and others: So that a Degree containing 500 Stadiums, and every Stadium 600 feet, it follows that a Degree muſt contain 300000 feet, exactly agreeing in number with the common received opinion in *England*, which therefore may ſeem to be hence derived, and would alſo receive much confirmation hereby (he being an Author of ſuch approved credit) if it could be approved that our *Engliſh* feet were exactly equal to the *Egyptian* or *Alexandrian* foot, where *Ptolomy* wrote. Otherwiſe that being true, that ſo many of their feet make a degree, it will follow, that if ours be greater, there be fewer of them contained in a degree; if leſſer (as undoubtedly they are) there muſt be more of them contained in a Degree.

*Philander* in his Commentary upon the third Chapter of the third Book of *Vitruvius*, hath expreſſed the quantity of the ancient *Roman* foot, where (by a competent allowance for the ſhrinking of the paper being printed wet) it may probably be gathered that it was ſomething longer then our Engliſh foot. But the *Alexandrian* and *Egyptian* foot was much greater; for according to *Hermochanicus*, 5 *Alexandrian* feet were equal to ſix *Roman* feet: ſeeing then the ancient Roman foot was ſomething greater then ours, the *Alexandrian* foot muſt needs be much greater then ours. So that whereas *Ptolomy* ſaith there are 500 *ſtadiums* in a degree, & as we have ſhewed a *Stadium* did conſiſt of 600 feet, theſe being *Egyptian* or *Alexandrian* feet, as it is moſt probable, being the place where *Ptolomy* lived; there muſt be a far greater number of our feet in a *Stadium*, & ſo in a degree, whence

it

it is evident, that there is no sufficient footing for this common opinion in the assertion of *Ptolomy*.

Neither doth the practise and experience of Mariners in their Voyages at Sea prove it: for there is no reckoning or experiment at Sea set down by any (that I have seen) to confirm it. And though it be true, that in sayling between two places that lie neer to one and the same Parallel, they ground their reckoning chiefly upon this supposition, that 300000 of our English feet make a Degree, yet can they seldome or never by those reckonings discern the Errour, the rather for that they have been, and for the most part are still kept upon the Plane or Common *Sea-chart*, which makes a Degree in any Parallel equal to a Degree in the Equinoctial; and so makes a Degree in any Parallel to contain 300000 feet. And it is true, that in some Parallel a Degree doth contain onely 300000 of our English feet; namely, about that Parallel which is in Latitude 35 degrees (as we shall further shew hereafter) neer unto which have the principal of our Eastern and Western Voyages been made. And thus though this opinion of 300000 feet in a Degree, and the projection of the *Common Chart* be very erroneous, yet because the errour of the one doth sometimes take the other, they could not be so easily discerned by Experience onely.

This opinion of 300000 English feet to a Degree, may seem also to be something confirmed by an Observation made by our Countrey-man Master *Edward Wright*, upon Mount *Edgecumbe* neer *Plimouth*, of the Semidiameter of the Earth, which he hath set down in his Book, *Of the Correction of Errours in Navigation*, Chapter 15. where he findes the *Semidiameter* to be 18321621 of our English feet, whence it may be gathered, that in a degree of a great Circle of the Earth, there should not be full out 300000 of our feet; but the way by him there used, though it was very fit for the end whereunto he there applies it, namely, to finde the dipping or depression of the apparent Horizon beneath the true, according to the heighth of the eye above the water; yet will it easily be granted to be no

no exact way for finding the *Semidiameter*, and consequently the Circumference of the Earth, or the quantity of a Degree on the same, and so he sayes there, that he used that way, because he wanted opportunity to put it in practice a more exact way. Wherefore for the further Satisfaction of my self and others in this Point, and chiefly for the necessary use it hath in the Practice of *Navigation*, I have made the Experiment following, that so the quantity of a Degree, and of the whole Compasse of the Earth might at least-wise be nearly known in our English measures.

## CHAP. II.

### *An Experiment made for finding the quantity of a Degree, and so of the Circumference of the Earth and Sea in our known measures.*

HAving occasion to be in the City of *York*, about the beginning of *June*, *Anno* 1635. I made there several Observations of the Meridian Altitude of the Sunne, the last of which was made the eleventh day of *June*; the Skie was every of those dayes something over-cast at noon, yet not so much but that an Observation might be made to a neer scantling. And because the last of these Observations is most fit for the present occasion, and that day was as clear as any of the other, we will here especially make use of that, being as followeth.

Upon the eleventh of *June* 1635. I made an Observation neer the middle of the City of *York*, of the meridian Altitude of the Sun, by an arch of a *Sextant* of more then five foot Semidiameter, and found the apparent Altitude of the Sun that day at noon to be 59 degrees 33 minutes.

I had also formerly upon the eleventh day of *June*, *Anno* 1633. observed in the City of *London*, neer the *Tower*, the appa-

apparent Meridian Altitude of the Sun, and found the same to be 62 deg. 1 min.

And seeing the Sunnes declination upon the eleventh day of *June* 1635, and upon the eleventh day of *June* 1633, was one and the same without any sensible difference; and because these Altitudes differ but little, we shall not need to make any alteration or allownance, in respect of Declination, Refraction, or Parallax: Wherefore substracting the lesser apparent Altitude; namely 59 degrees 33 minutes, from the greater 62 degrees 1 minute, there remaines 2 degrees 28 minutes, which is the difference of Latitude of these two Cities; namely, of *London* and *York*.

Also, by the foresaid Observation made in *York*, it appeares, that the Latitude of that City is 53 degrees 58 minutes almost.

But to our purpose, comming at that time from thence to *London*, I further found by measure, that the Parallel of *York* is from the parallel of *London*, 9149 Chains; every Chaine being six Poles, and every Pole 16½ of our English Feet; that is, every Chain ninety nine Feet. (After what manner I found this to be so, we shall further expresse hereafter:) But thus, as I say, I found that *York* is more Notherly then *London*, by 9149 Chaines: And before, we have noted that these two places differ in Latitude 2 degrees 28 minutes: therefore it followes, that 2 degrees 28 minutes of the Meridian on the Earth and Sea, is equal to 9149 Chains. And if accordingly we would know how many of these Chains are contained in one degree, we may finde that by the Rule of Proportion, first reducing the Degrees into minutes, and then say,

If the difference of Latitude 148. *co. ar.* 7.829274
give such a number of Chaines, 9149 3.961137
Then one Degree, that is 60 1.778151
gives of such Chaines 3709 3.569562

and somewhat more, namely, five Feet, which reduced into Feet, make 367196, that is, 367200 Feet in a Degree, lacking four Feet, which here we regard not.

chains 9149
6
Poles 54894
5,5
27447.
27447.
30917.
3.
feet. 905751
148
fin.1.min. 6120
× 60
fin.deg. 367200
fin.M. 5280
69. M 2880 ft

Thus then according to this Experiment, it is evident that one degree of a great Circle measured on the Earth, is neer 367200 feet, which in our Poles of 16 ½ feet, is 22254 poles, and about one half, and these reduced into Furlongs, at 40 poles to the Furlong, make 556 Furlongs and 14 Poles, and lastly, these reduced into our English miles of eight Furlongs to a mile, make 69 miles, and 4 Furlongs, 14 Poles, that is 69½ miles, and 14 Poles to a Degree.

And hence according to the most approved *Hypothesis* of the *Sphericity* of this *Terrestrial Globe*, we may finde the compasse of it, as followeth. But first, you may note, that we speak not here of the compasse of the Earth in any Parallel or lesser Circle described upon any side thereof, (that being various according to the different distance of those Circles from their Poles) but of the Compasse taken in the middle or greatest thicknesse of the Globe, namely, in any great Circle, such as divide the whole Globe into two equal parts, of which kinde are the Equinoctial and all Meridians, &c. this being properly the *Perimeter*, or Compasse of a *Spherical Body*.

Now seeing a Degree is the 360 part of the circumference of a Circle (for any Circumference being divided actually, or by supposition into 360 equal parts, those parts are called Degrees) if we can finde how many Feet, Paces, Miles, or other known measures are contained in one of those Degrees, then shall we easily conclude how many of the same known measures are contained in the whole Circumference. But by the forsaid Experiment we finde, that in one Degree of a great Circle on the Spherical Superficies of the earth, there is contained 367200 Feet; therefore it is evident, that 360 times 367200 feet is the Compasse of the whole; wherefore multiplying 367200 by 360, the Product is 132192000 feet, which reduced into Poles, is 8011636, and these reduced into Furlongs, are 200290 Furlongs 36 Poles; and lastly, these reduced into miles are 25036 English miles, and somewhat more for the circuit of the Earth and Sea.

If further we desire the Diameter and Semidiameter of the

Earth, forasmuch as it is proved by *Archimedes*, that the proportion of the circumference of a Circle is to the Diameter thereof, almost as 22 to 7. Therefore by the Rule of Proportion, As 22 to 7; So is the Circumference of the Earth, to the Diameter thereof: So that multiplying the Circumference of the Earth, namely, 123129006 feet by 7, and dividing the Product, namely, 925541002, by 22, the quotient, namely, 42068092 is the Diameter of the Earth in Feet, the half whereof, namely, 21034045 Feet, is the Semidiameter of the same, being 21 millions of Feet, and somewhat more; these reduced into English miles, as before we did the Circumference, shew the Diameter of the Earth to be 7968 miles, and somewhat more, and the Semidiameter 3985. And thus we have the Circumference, Diameter, and Semidiameter of the Earth, as also the quantity of a Degree of the same Circumference in known measures of Feet, Furlongs, and Miles, &c. There are onely two things here, which may seem doubtfull, namely, the Experiment it self, and the *Hypothesis* of the Sphericity of this *Terrestrial Globe* consisting of the Earth and Sea, for these being admitted, the measures thence deduced as before, will necessarily follow.

Now touching the Experiment, I confesse, that to have made it so exactly as were requisite, and in all points so as I shall shew in the Chapter following, would have required much more time and expence then mine ability would reach unto; Yet having made Observation at Sea, as afore said, I measured (for the most part) the Way from thence to *London*, and where I measured not, I paced; (wherein through custome I usually come very near the truth) observing all the way as I came, with a Circumferentor, all the principal Angles of position or windings of the way, (with convenient allowance for other lesser Windings, Asterns, and Descents) and these I laid not down by a Protracter after the usual manner; but framed a Table much more ready and fit for this purpose, as we shall after shew; so that I may affirme the Experiment to be neer the truth.

Touching

Touching the *Hypotheſis* that the Earth and Sea make one Spherical or round Body, it is generally agreed upon by all the Philoſophers, Aſtronomers, Geographers, and Navigators, ancient and modern, ſome reaſons demonſtrative for the confirmation thereof may be theſe.

Firſt the Eclipſes, eſpecially of the Moon, which are cauſed by the ſhadow of the Body of the Earth being interpoſed between the Sun and the Moon, and as much as this ſhadow doth fall upon the Moon, alwayes and on every ſide circular, and ſo appears to us, it is manifeſt by the Opticks, that the Earth from whence it proceeds is a Spherical Body.

Secondly, likewiſe the Eclipſes of the Sun, which are cauſed by the interpoſition of the Moon between the Sunne and thoſe places where it appears Eclipſed; I ſay it could not be determined when and in what place ſuch an Eclipſe ſhould appear, and where not, if the form of the Earth were not known; but ſeeing the places where ſuch Eclipſes happen, and where not, may be and are uſually determined, and that upon this ground; that the ſurface of the Earth is ſpherical, it is thence alſo ratified to be a truth.

Thirdly, the Sunne, Moon, and Starres do riſe and ſet, and are upon the Meridian ſooner to thoſe that are reſident in the Eaſtern parts, then to others more Weſterly, and that in a proportion anſwerable to the roundneſſe of the Earth, as the Planets and ſtars are upon our Meridian at *London* ſooner by almoſt four houres, then they are to thoſe that inhabit *Summer Iſlands*, and the confines of *Virginia* and *New-England*; And ſo in *Eaſt-India*, and other Eaſtern Regions, the Sunne and ſtarres are ſooner upon their Meridian then upon ours, which is manifeſt to be ſo, as by other reaſons, ſo eſpecially by the Eclipſes of the Moon; for an Eclipſe of the Moon hath not in it ſelf any diverſity of time, being at one and the ſame inſtant without reſpect of places, yet becauſe in the Eaſtern parts the day is begun, and it may be far ſpent before it begin in places farre Weſterly, therefore ſuch an Eclipſe may appear to the Eaſtern Inhabitants towards the end of their night, which to the Weſtern appears

peares in the beginning or middle of the same night with them, and so the difference will be more or lesse, according to the different distance of those places in Longitude.

Fourthly, furthermore we see, that going or sayling to the Northwards, we have the Artick Pole and Southern Stars more elevated, and the Antartick Pole and Northern Starres more depressed, the Elevation Northerly increasing equally, with the depression Southerly, and either of them proportional to the distances which we goe: the like happeneth in going to the Southwards. Besides the Oblique Ascensions, Descensions, Occultations, Emersions, and Amplitudes of Rising and Setting of the Sunne and Starres, in every several Latitude, agreeable to the *Hypothesis* of the Earths Sphericity. All which could not be so, if the Earth were of any other then of a Spherical form.

Fifthly, so if we stand upon the Sea-shore, and see a Ship farre off under sail making towards the Land, at first we see onely the Top-sails or highest parts, and withall doe manifestly behold the convex Superficies of the Sea, as it were raised and interposing it self between our sight and the Hull or lower parts of the Ship, till she approachech neerer, and this uniformely, every wayes alike, and proportionably to the several distances which evidently demonstrate the Spherical roundnesse thereof.

Sixthly, And lastly, (to adde no more) the Navigations of these later times make it apparent, those especially that have been made round about the World, as those two Voyages by our famous Countrey-men Sir *Francis Drake*, and Mr. *Thomas Candish*, both which severally sayling from our Coasts to the *West-Indies*, and passing the straights of *Magellane*, continued their course Westerly, till they came into those parts, which are from us to the Eastwards; namely, to the *East-Indies*, and so sailed still Westerly till they came to *Cap bon Esperance*, and thence returned into *England*, having sailed about the whole Terrestial-Globe, they found nothing by their Observations or reckonings dissonant from the uniforme *Sphericity* thereof

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in all its parts. That they came short in the number of dayes one, and reckoned the time of their absence lesse by one day and a night then they which remained at home, this further confirms the thing in hand.

Yet whilst we speak here of the Roundnesse of the Earth and Sea, we intend it not so strictly as if it were a thing turned round without any inequality in its Superficies: But as a Bowl or Ball, though it have some dust or small grains of sand cleaving thereto, may still be said to be round. So though the Lands, Hills and Mountains be somewhat raised above the Spherical Superficies of the Sea, and if there should be also some Valleys or bottomes more depressed; yet seeing the greatest of these inequalities have scarce any sensible proportion to the whole, we may well affirm the Whole to be round.

The relations made of the prodigious height of some Mountains, as to be 60 or 70 Miles high, if it be understood of their perpendicular or direct height are fabulous; The Mount *Atlas* is recorded by some of the Ancients, to reach up almost to the Moon, and to be as it were a Piller for the Heavens to rest upon, being measured Geometrically by *Eratosthenes*, the perpendicular or upright height from the top thereof to the Valleys beneath, was found not to exceed ten *Stadiums*, which of our English measures is little more then a Mile and a quarter, a *Stadium* not much differing from our Furlong, and the like might be shewed of others.

But if we admit the highest Mountain to rise perpendicularly above the Spherical Superficies of the Sea two miles, yet seeing the Diameter or whole thicknesse of the Earth, is as we have before shewed 7966 Miles, this exorbitancy or difference of two Miles is of small moment; yea, if there were any Mountain eight Miles in height upright, yet this compared with the whole thicknesse of the Earth is little more then one thousand part thereof; therefore we may conclude, that this *Terrestrial Globe consisting* of the Earth and Sea is *Spherical*. We come in the next place to shew by what way of measuring we found the Parallel of *York* to be distant from the Parallel of *London*,

9149

or 49 Chains. And so how the distance of the Parallels of two Places may be exactly measured.

## CHAP. III.

### *A most exact way for finding the quantity of the Diameter and Circumference of the Earth and Sea, and of a Degree on the same.*

I Do the more fully set down the way of making this Experiment, that so I may give occasion to any who are so nobly minded for a publique good, as to be at that charge to make a further and more exact trial thereof. Now then the best and perfectest way is, to observe so exactly as may be the Summer *Solstitial Altitudes* of the Sunne at two places, so farre distant asunder, and lying so neer North and South each from other, with so direct and fair a way between them, as conveniently may be chosen: Suppose for example *Christ-Church* and *Berwick*, or some other place in the furthest parts of *Scotland*, for the further these two places are each from other: the more perfectly may this businesse be performed. Then measure as truly as is possible, and set down in a Book, all the way between those two places, with all the Windings, Ascents and Descents that are therein, whereby with help of the insuing Table, you may easily and exactly finde how much the one place is more Southerly then the other. For this purpose the *Plain Table* is not the fittest Instrument, but rather a *Theodolite* or *Peractor*, or some other of that kind, observing diligently the Variation of the Needle. The Chain may be six poles long, or rather 100 feet, & the Table fitted accordingly (but the Table following is for poles) if it should be much longer, it would be too heavy.

The High-wayes are commonly crooked, yet because of sundry obstacles and impediments which are incident out of the way, and because a man cannot certainly at first direct himself the neerest and best way to the place intended, it would be ex-

in all its parts. That they came short in the number of dayes one, and reckoned the time of their absence lesse by one day and a night then they which remained at home, this further confirms the thing in hand.

Yet whilst we speak here of the Roundnesse of the Earth and Sea, we intend it not so strictly as if it were a thing turned round without any inequality in its Superficies: But as a Bowl or Ball, though it have some dust or small grains of sand cleaving thereto, may still be said to be round. So though the Lands, Hills, and Mountains be somewhat raised above the Spherical Superficies of the Sea, and if there should be also some Valleys or bottomes more depressed; yet seeing the greatest of these inequalities have scarce any sensible proportion to the whole, we may well affirm the Whole to be round.

The relations made of the prodigious height of some Mountains, as to be 60 or 70 Miles high, if it be understood of their perpendicular or direct height are fabulous; The Mount *Atlas* is recorded by some of the Ancients, to reach up almost to the Moon, and to be as it were a Piller for the Heavens to rest upon, being measured Geometrically by *Eratosthenes*, the perpendicular or upright height from the top thereof to the Valleys beneath, was found not to exceed ten *Stadiums*, which of our English measures is little more then a Mile and a quarter, a *Stadium* not much differing from our Furlong, and the like might be shewed of others.

But if we admit the highest Mountain to rise perpendicularly above the Spherical Superficies of the Sea two miles, yet seeing the Diameter or whole thicknesse of the Earth, is as we have before shewed 7966 Miles, this exorbitancy or difference of two Miles is of small moment; yea, if there were any Mountain eight Miles in height upright, yet this compared with the whole thicknesse of the Earth is little more then one thousand part thereof; therefore we may conclude, that this *Terrestrial Globe consisting* of the Earth and Sea is *Spherical*. We come in the next place to shew by what way of measuring we found the Parallel of *York* to be distant from the Parallel of *London*,

9149

91 49 Chains. And so how the distance of the Parallels of two Places may be exactly measured.

## CHAP. III.

### *A most exact way for finding the quantity of the Diameter and Circumference of the Earth and Sea, and of a Degree on the same.*

I Do the more fully set down the way of making this Experiment, that so I may give occasion to any who are so nobly minded for a publique good, as to be at that charge to make a further and more exact trial thereof. Now then the best and perfectest way is, to observe so exactly as may be the Summer *Solstitial Altitudes* of the Sunne at two places, so farre distant asunder, and lying so neer North and South each from other, with so direct and fair a way between them, as conveniently may be chosen: Suppose for example *Christ-Church* and *Berwick*, or some other place in the furthest parts of *Scotland*, for the further these two places are each from other: the more perfectly may this businesse be performed. Then measure as truly as is possible, and set down in a Book, all the way between those two places, with all the Windings, Ascents and Descents that are therein, whereby with help of the insuing Table, you may easily and exactly finde how much the one place is more Southerly then the other. For this purpose the *Plain Table* is not the fittest Instrument, but rather a *Theodolite* or *Peractor*, or some other of that kind, observing diligently the Variation of the Needle. The Chain may be six poles long, or rather 100 feet, & the Table fitted accordingly (but the Table following is for poles) if it should be much longer, it would be too heavy.

The High-wayes are commonly crooked, yet because of sundry obstacles and impediments which are incident out of the way, and because a man cannot certainly at first direct himself the neerest and best way to the place intended, it would be expedient

pedient to measure the distance as aforesaid; First, in the High-wayes, leading from the one to the other, and then in the neareſt and beſt way that could be choſen between them, and ſo if any notable Errour happen in the one, it may be diſcovered and amended in the other. The form which I obſerved in ſetting down the meaſures and angles, was according to this Example.

| *Deg.* | | *Diſtance.* | *North* | *South.* | *East.* | *Weſt.* |
|---|---|---|---|---|---|---|
| *S E* | 31 | | | | | |
| *S E* | 20 | | | | | |
| *S E* | 13 | | | | | |
| *S E.* | 13 | | | | | |
| *S W.* | 02 | | | | | |
| *S E.* | 05 | | | | | |

It is to be underſtood, that the Table here following was before calculated to ſerve inſtead of a *Protractor*, for a Circumferentor or other Graduated Inſtrument, and for a Chain of three Poles, which for the moſt part I uſe; yet it may very well be applyed to a Chain of ſix Poles, (as in this buſineſſe it was) reckoning every Chain to be two, &c. And thus for every ten Chains of ſix Poles to a Chain I make two ſtroaks, ſignifying two Changes or 20 Chains, and if there be any odde Chains, for thoſe I ſet a figure in another line next below; and if moreover any odde Poles, whether one or two; for thoſe I ſet another figure in a third line below.

Thus the laſt entrance before-going, being *S E.* 05 Degrees, ⫶⫶⫶⫶⫶ ſignifies that the Line upon which I went,

5.
2

was from the South-part of the Meridian to the Eaſtwards, making

king an angle with the Meridian of 5 Degrees, the nine ſtroaks ſignifie nine Changes, or ninety Chains, the figure 5 ſignifieth five Chaines, and the figure 2 two poles. So that it is to be read thus; South-Eaſterly 5 Degrees, 9 Changs, 5 Chains, and 2 Poles; and the like is to be underſtood of the reſt. But for the moſt part having liberty of ground, I end the meaſure of every line, either with a whole number of Changes, or at leaſt of Chains.

And thus proceeding all day, towards the Evening, or when elſe I have time convenient, I reduce all theſe Diſtances, upon what Lines or Angles ſoever they be, to Diſtances of *North* or *South*, *Eaſt* or *Weſt*, as here appears.

| *Deg.* | *Diſtance.* | *North.* | *South.* | *Eaſt.* | *Weſt.* |
|---|---|---|---|---|---|
| | | | 2571 | 1545 | |
| *S E* 31 | | | 2819 | 1026 | |
| *S E* 20 | | | 1692 | 616 | |
| | | | 0169 | 062 | |
| *S E* 13 | | | 2923 | 675 | |
| *S E* 13 | | | 1754 | 404 | |
| | | | 1499 | — | 052 |
| *S W* 02 | | | 2690 | 235 | |
| *S E* 05 | | | 0149 | 013 | |
| | | | 0020 | 002 | |
| Chaines. | 171 | | 16286 | 4578 | 052 |
| | 2 | | 0 | 52 | |
| Poles. | 171 5 | | 16286 | 4526 | |

We will explain the laſt, and ſo the reſt may eaſily be underſtood: *S E.* 5 deg. |||||||||-5. 2. here becauſe I have *S E.* the numbers taken out of the Table muſt be put into the Columns entituled *South* and *Eaſt*. Then in the table under 5 deg. I look for 9 Changes, and finde againſt it 2690, and in the adjacent col. under the compl. thereof 235, and becauſe *S E* 5 deg. is leſſe then 45 deg. that is neerer to the South then to the *E.* I put in the col. entituled *South* 2690, and in that entituled *Eaſt* 235; then again

in the ſame Tabular Column under 5 degrees, I finde againſt 5 Chains, (cutting off a Figure; becauſe 5 Chains is but the tenth part of 5 Chaines) 149 to be put in the *South* Column, and 13 for the *Eaſt* Column.

Laſtly, againſt 2 poles I finde for the *South* Column 20, and for the *Eaſt* 2, and the like is to be underſtood of all the reſt.

Now ſuppoſing this laſt to be a place, whoſe Diſtance and Scituation from the firſt is required, I ſum up the Columns ſeverally and of the *North* and *South* Columns ſubſtract the leſſer from the greater, and ſo of the *Eaſt* and *Weſt* Columns; and ſo it will appear how much *North* or *South*, and how much *Eaſt* or *Weſt* the laſt place is from the firſt.

As in this Example, we finde the laſt place to be to the Southwards of the firſt 1628 Poles, for the laſt figure may be cut off, being uſed in the Table, onely for the more exactneſſe, or may be made a Fraction, and ſo it is 1628, $\frac{6}{10}$ Poles; Likewiſe the laſt place is to the Eaſtwards of the firſt 452 $\frac{6}{10}$ Poles, and thus I proceed all the way.

Now touching the angles of aſcent and deſcent of Hills and Valleyes, to have obſerved them exactly, would have required more time and charge then I could of my ſelf beſtow; yet I made allowance for ſuch of them as were of moſt moment, he that would obſerve them all, may either make two or three Columns more, or keep an account of them apart by themſelves. But if he intend no further uſe of them, but to finde the neereſt diſtance, he need not ſet them down, but make allowance for them on the ground, keeping his diſtance intire without Fractions.

As admit I obſerve the aſcent from a Valley to the brow of a Hill to be 14 degrees above the Level or Horizontal Line, and that meaſuring, I finde the diſtance to be 30 poles; I turn to the Table, and under 14 degrees, and againſt 10 Chains, I finde 291, and 726, ſhewing that the Level or Horizontal diſtance from my Station to that Brow is onely 29 $\frac{11}{100}$ Poles, and that the height of that Brow above the Level Line, is 7 $\frac{26}{100}$ Poles: But finding thus that the *Hypothenuſal* being 30, the

*Bac*

*Base* or *level line* is but 29 $\frac{11}{100}$, that is lesse by $\frac{89}{1000}$, because I would avoid this Fraction, I adde to the end of the foresaid measure of 30 poles upon a level Line $\frac{89}{100}$ of a Pole, and then I may account my self distant from the place in the Valley where I made Observation 30 poles in a *level* or *Horizontal line*, and so set down the distance without a Fraction: the like is to be understood of all other Ascents and Descents.

## *Here followeth the Table.*

| | 1 deg. | 89 d. | 2 d. | 88 d. | 3 d. | 87 d. | 4 d. | 86 d. | 5 d. | 85 d. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 300 | 5 | 300 | 10 | 300 | 15 | 299 | 21 | 299 | 26 |
| 2 | 600 | 10 | 600 | 21 | 600 | 31 | 599 | 42 | 598 | 52 |
| 3 | 900 | 15 | 900 | 31 | 899 | 46 | 898 | 63 | 896 | 79 |
| 4 | 1200 | 20 | 1200 | 42 | 1198 | 62 | 1198 | 84 | 1195 | 105 |
| 5 | 1500 | 26 | 1500 | 53 | 1497 | 78 | 1497 | 105 | 1494 | 131 |
| 6 | 1800 | 31 | 1799 | 64 | 1798 | 93 | 1796 | 126 | 1794 | 157 |
| 7 | 2100 | 37 | 2099 | 74 | 2097 | 110 | 2095 | 147 | 2093 | 183 |
| 8 | 2400 | 42 | 2398 | 84 | 2397 | 124 | 2394 | 168 | 2391 | 209 |
| 9 | 2700 | 47 | 2698 | 95 | 2696 | 140 | 2694 | 189 | 2690 | 235 |
| 10 | 3000 | 52 | 2998 | 105 | 2996 | 157 | 2993 | 210 | 2989 | 262 |
| 1 | 10 | 00 | 10 | 0 | 10 | 0 | 10 | 1 | 10 | 1 |
| 2 | 20 | 00 | 20 | 1 | 20 | 1 | 20 | 1 | 20 | 2 |

| | 6deg. | 84 d. | 7 d. | 83 d. | 8 d. | 82 d. | 9 d. | 81 d. | 10 d. | 80 d. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 298 | 31 | 298 | 37 | 297 | 42 | 296 | 47 | 295 | 52 |
| 2 | 597 | 62 | 596 | 74 | 594 | 84 | 592 | 94 | 590 | 104 |
| 3 | 895 | 94 | 894 | 111 | 891 | 125 | 889 | 140 | 887 | 156 |
| 4 | 1193 | 126 | 1192 | 146 | 1188 | 167 | 1185 | 187 | 1182 | 208 |
| 5 | 1492 | 157 | 1489 | 183 | 1485 | 209 | 1481 | 234 | 1477 | 260 |
| 6 | 1780 | 188 | 1787 | 220 | 1782 | 251 | 1777 | 281 | 1772 | 312 |
| 7 | 2089 | 223 | 2085 | 257 | 2080 | 292 | 2074 | 328 | 2069 | 365 |
| 8 | 2386 | 251 | 2383 | 292 | 2377 | 334 | 2371 | 375 | 2364 | 417 |
| 9 | 2686 | 282 | 2680 | 329 | 2674 | 376 | 2667 | 422 | 2659 | 469 |
| 10 | 2984 | 314 | 2978 | 366 | 2971 | 418 | 2963 | 469 | 2954 | 521 |
| 1 | 10 | 1 | 10 | 1 | 10 | 1 | 10 | 1 | 10 | 1 |
| 2 | 20 | 2 | 20 | 2 | 20 | 3 | 20 | 3 | 20 | 3 |

| | 11 d. | 79 d. | 12 d. | 78 d. | 13 d. | 77 d. | 14 d. | 76 d. | 15 d. | 75 d. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 295 | 57 | 293 | 62 | 292 | 67 | 291 | 73 | 290 | 78 |
| 2 | 590 | 114 | 586 | 142 | 584 | 134 | 582 | 146 | 580 | 156 |
| 3 | 883 | 172 | 881 | 188 | 876 | 203 | 873 | 219 | 870 | 233 |
| 4 | 1178 | 229 | 1174 | 250 | 1169 | 270 | 1164 | 290 | 1160 | 310 |
| 5 | 1473 | 286 | 1467 | 312 | 1461 | 337 | 1455 | 363 | 1449 | 388 |
| 6 | 1768 | 343 | 1760 | 374 | 1754 | 404 | 1746 | 436 | 1739 | 466 |
| 7 | 2068 | 401 | 2055 | 436 | 2047 | 472 | 2038 | 508 | 2030 | 543 |
| 8 | 2355 | 458 | 2348 | 500 | 2339 | 540 | 2329 | 580 | 2320 | 621 |
| 9 | 2650 | 515 | 2641 | 562 | 2631 | 608 | 2620 | 653 | 2610 | 699 |
| 10 | 2946 | 572 | 2934 | 624 | 2929 | 675 | 2911 | 726 | 2898 | 776 |
| 1 | 10 | 2 | 10 | 2 | 10 | 2 | 10 | 2 | 10 | 3 |
| 2 | 19 | 4 | 19 | 4 | 19 | 4 | 19 | 4 | 19 | 5 |

16 d.

| | 16 d. | 74 d | 17 d. | 73 d. | 18 d. | 72 d. | 19 d. | 71 d. | 20 d. | 70 d. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 288 | 83 | 287 | 88 | 285 | 93 | 284 | 98 | 282 | 103 |
| 2 | 576 | 166 | 574 | 177 | 570 | 186 | 568 | 196 | 564 | 206 |
| 3 | 865 | 250 | 861 | 264 | 855 | 279 | 851 | 294 | 846 | 308 |
| 4 | 1153 | 332 | 1148 | 352 | 1140 | 371 | 1135 | 391 | 1128 | 411 |
| 5 | 1442 | 413 | 1434 | 438 | 1426 | 463 | 1418 | 488 | 1410 | 513 |
| 6 | 1730 | 496 | 1721 | 526 | 1711 | 556 | 1702 | 586 | 1691 | 616 |
| 7 | 2019 | 580 | 2008 | 615 | 1997 | 649 | 1986 | 684 | 1973 | 719 |
| 8 | 2307 | 663 | 2296 | 703 | 2282 | 743 | 2270 | 782 | 2255 | 822 |
| 9 | 2596 | 746 | 2583 | 791 | 2567 | 836 | 2552 | 880 | 2537 | 924 |
| 10 | 2884 | 827 | 2869 | 877 | 2853 | 927 | 2836 | 977 | 2819 | 1026 |
| 1 | 10 | 3 | 10 | 3 | 10 | 3 | 10 | 3 | 10 | 3 |
| 2 | 20 | 5 | 19 | 6 | 19 | 6 | 19 | 6 | 19 | 6 |

| | 21 d. | 69 d. | 22 d. | 68 d. | 23 d. | 67 d. | 24 d. | 66 d. | 25 d. | 25 d. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 280 | 107 | 278 | 112 | 276 | 117 | 274 | 122 | 272 | 127 |
| 2 | 560 | 215 | 556 | 224 | 552 | 234 | 548 | 244 | 544 | 254 |
| 3 | 840 | 322 | 834 | 337 | 828 | 351 | 822 | 366 | 816 | 381 |
| 4 | 1120 | 429 | 1112 | 449 | 1104 | 468 | 1096 | 488 | 1088 | 508 |
| 5 | 1400 | 537 | 1391 | 562 | 1380 | 586 | 1370 | 610 | 1360 | 634 |
| 6 | 1680 | 645 | 1669 | 674 | 1656 | 703 | 1644 | 732 | 1632 | 761 |
| 7 | 1960 | 752 | 1947 | 786 | 1932 | 820 | 1918 | 854 | 1904 | 888 |
| 8 | 2240 | 860 | 2225 | 899 | 2209 | 937 | 2192 | 976 | 2175 | 1015 |
| 9 | 2521 | 968 | 2504 | 1011 | 2485 | 1054 | 2466 | 1098 | 2447 | 1142 |
| 10 | 2801 | 1075 | 2782 | 1124 | 2761 | 1172 | 2740 | 1220 | 2719 | 1268 |
| 1 | 9 | 4 | 9 | 4 | 9 | 4 | 9 | 4 | 9 | 4 |
| 2 | 18 | 7 | 18 | 2 | 18 | 8 | 18 | 8 | 18 | 8 |

| | 26 d. | 64 d. | 27 d. | 63 d. | 28 d. | 62 d | 29 d. | 61 d. | 30 d. | 60 d. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 270 | 131 | 267 | 136 | 265 | 141 | 202 | 145 | 260 | 150 |
| 2 | 540 | 263 | 534 | 272 | 530 | 282 | 524 | 290 | 520 | 300 |
| 3 | 810 | 394 | 801 | 408 | 795 | 423 | 786 | 435 | 780 | 450 |
| 4 | 1079 | 525 | 1068 | 544 | 1060 | 564 | 1048 | 581 | 1040 | 600 |
| 5 | 1348 | 657 | 1336 | 681 | 1324 | 704 | 1312 | 727 | 1299 | 750 |
| 6 | 1618 | 788 | 1603 | 817 | 1589 | 845 | 1574 | 872 | 1559 | 900 |
| 7 | 1888 | 919 | 1870 | 953 | 1855 | 986 | 1836 | 1017 | 1819 | 1050 |
| 8 | 2157 | 1050 | 2138 | 1089 | 2120 | 1127 | 2098 | 1162 | 2079 | 1200 |
| 9 | 2427 | 1182 | 2405 | 1225 | 2384 | 1267 | 2361 | 1308 | 2339 | 1350 |
| 10 | 2696 | 1315 | 2673 | 1362 | 2649 | 1408 | 2624 | 1454 | 2598 | 1500 |
| 1 | 9 | 4 | 9 | 5 | 9 | 5 | 9 | 5 | 9 | 5 |
| 2 | 18 | 8 | 18 | 10 | 18 | 10 | 18 | 10 | 18 | 10 |

| | 31 d. | 59 d. | 32 d. | 58 d. | 33 d. | 157 d. | 34 d. | 56 d. | 35 d. | 55 d. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 257 | 154 | 254 | 159 | 252 | 163 | 249 | 168 | 246 | 172 |
| 2 | 514 | 309 | 508 | 318 | 504 | 326 | 498 | 336 | 492 | 344 |
| 3 | 773 | 463 | 763 | 477 | 755 | 489 | 747 | 504 | 738 | 516 |
| 4 | 1028 | 617 | 1017 | 636 | 1007 | 653 | 995 | 671 | 983 | 688 |
| 5 | 1285 | 772 | 1272 | 795 | 1258 | 817 | 1243 | 838 | 1228 | 860 |
| 6 | 1542 | 927 | 1526 | 955 | 1510 | 980 | 1492 | 1006 | 1474 | 1032 |
| 7 | 1809 | 1081 | 1780 | 1113 | 1762 | 1143 | 1741 | 1174 | 1720 | 1204 |
| 8 | 2057 | 1235 | 2034 | 1272 | 2013 | 1307 | 1990 | 1342 | 1966 | 1377 |
| 9 | 2314 | 1390 | 2288 | 1431 | 2265 | 1470 | 2238 | 1510 | 2212 | 1549 |
| 10 | 2571 | 1545 | 2544 | 1590 | 2516 | 1634 | 2487 | 1677 | 2457 | 1721 |
| 1 | 9 | 5 | 8 | 5 | 8 | 5 | 8 | 6 | 8 | 6 |
| 2 | 18 | 10 | 16 | 10 | 16 | 10 | 16 | 12 | 16 | 12 |

| | 36 d. | 54 d. | 37 d. | 53 d. | 38 d. | 52 d | 39 d. | 51 d. | 40 d | 50 d. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 243 | 176 | 240 | 180 | 236 | 185 | 233 | 189 | 230 | 193 |
| 2 | 486 | 352 | 480 | 360 | 472 | 370 | 466 | 378 | 460 | 386 |
| 3 | 729 | 528 | 720 | 541 | 709 | 555 | 699 | 567 | 690 | 578 |
| 4 | 971 | 705 | 960 | 721 | 945 | 739 | 932 | 756 | 920 | 771 |
| 5 | 1213 | 881 | 1198 | 902 | 1182 | 923 | 1165 | 944 | 1149 | 964 |
| 6 | 1456 | 1057 | 1438 | 1082 | 1418 | 1108 | 1398 | 1133 | 1379 | 1157 |
| 7 | 1699 | 1234 | 1678 | 1262 | 1654 | 1293 | 1631 | 1322 | 1609 | 1350 |
| 8 | 1942 | 1410 | 1918 | 1443 | 1890 | 1479 | 1865 | 1511 | 1839 | 1543 |
| 9 | 2185 | 1586 | 2157 | 1624 | 2126 | 1663 | 2098 | 1700 | 2069 | 1735 |
| 10 | 2427 | 1763 | 2396 | 1805 | 2364 | 1847 | 2331 | 1888 | 2298 | 1928 |
| 1 | 8 | 6 | 8 | 6 | 8 | 6 | 8 | 6 | 8 | 6 |
| 2 | 16 | 12 | 16 | 12 | 16 | 12 | 16 | 12 | 16 | 12 |

| | 41 d. | 49 d | 42 d. | 48 d. | 43 d. | 47 d. | 44 d. | 46 d. | 45 d. | 45 d |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 226 | 197 | 223 | 201 | 219 | 205 | 216 | 208 | 212 | 212 |
| 2 | 452 | 394 | 446 | 402 | 438 | 410 | 432 | 416 | 424 | 424 |
| 3 | 678 | 591 | 669 | 603 | 658 | 614 | 648 | 625 | 636 | 636 |
| 4 | 905 | 788 | 892 | 803 | 878 | 819 | 864 | 833 | 849 | 849 |
| 5 | 1132 | 984 | 1114 | 1003 | 1097 | 1023 | 1079 | 1042 | 1061 | 1061 |
| 6 | 1358 | 1181 | 1337 | 1204 | 1316 | 1228 | 1295 | 1250 | 1273 | 1273 |
| 7 | 1584 | 1378 | 1560 | 1406 | 1535 | 1433 | 1511 | 1458 | 1485 | 1485 |
| 8 | 1810 | 1575 | 1783 | 1607 | 1754 | 1638 | 1727 | 1666 | 1697 | 1697 |
| 9 | 2036 | 1772 | 2006 | 1807 | 1974 | 1842 | 1943 | 1874 | 1910 | 1910 |
| 10 | 2264 | 1968 | 2229 | 2007 | 2194 | 2046 | 2158 | 2084 | 2122 | 2122 |
| 1 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| 2 | 16 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |

The Structure of this Table is from this ground:

As *Radius* is in proportion to the Distance of two places measured in their Rumbe, so is the Sine of the complement of that Rumbe, to the difference in latitude of these two places.

And so is the sine of that Rumbe, to the distance of the Meridians of those two Places. As admit I measure South-Easterly 20 deg. 300 Poles, here then the Rumb upon which I measure, making with the Meridian an angle of 20 degrees, I say,

As *Radius* is in proportion

| | |
|---|---|
| to the distance measured 300 poles | 2.47712 |
| So is the sine complement the Rumb, S E 20 deg. | 9.97299 |
| to the Difference of latitude 281 $\frac{21}{100}$ *fere.* | 2.45011 |

Whereby it appears, that the distance of the Parallels of these two places is 281 $\frac{21}{100}$ Poles; or that the place whereto I measure, is more Southerly then the place from which I measured, by 281 $\frac{21}{100}$ poles. Now for the distance of their Meridians, say,

As *Radius* is in proportion

| | |
|---|---|
| to the distance measured 300 poles; | 2.47712 |
| So is the sine of the Rumb S E 20 deg. | 9.53405 |
| to their distance in longitude 102 $\frac{606}{1000}$ | 2.01117 |

| *Ch* | *Poles* |
|---|---|
| 1 | 28.19 |
| 2 | 56.38 |
| 3 | 84.57 |
| 4 | 112.76 |
| 5 | 140.95 |
| 6 | 169.14 |
| 7 | 197.33 |
| 8 | 225.52 |
| 9 | 253.71 |
| 10 | 281.92 |

And thus I finde the place whereto I measured is more Easterly then the place from which I measured by 102 $\frac{6}{10}$ poles, and somewhat more. And in like sort may be found all the other numbers expressed in this Table; but having thus found for every Degree to 45 Degrees two numbers, the rest may be deduced from them, as in this Example: 300 poles at three poles to the Chain, is an hundred Chaines or ten Changes, finding that in ten Changes upon this Degree, the difference Southerly is 281 $\frac{21}{100}$ poles, it must be for five Changes, which is just halfe so much

by

by almoſt 141, and for one Change, which is a tenth part 28 $\frac{4}{10}$ *ferè*, and ſo for two Changes twice ſo much, that is, 56 $\frac{8}{10}$, for three Changes thrice ſo much, that is, the ſumme of the two former, namely, 84 $\frac{2}{10}$, and ſo by Addition onely you may finde the reſt, as in this Table, which I ſhall need to proſecute no further. And thus you may make it to the hundreth or thouſand parts of a Pole, but this for ordinary occaſions, for which it was at firſt intended, may ſuffice.

And according to this Example, it will be eaſie to frame the like Table for a Chain of any other ſize, or for any other meaſure which you uſe.

It may be objected, that howſoever this Rule holds true in Plain Triangles, yet the Triangles here uſed are neither plain nor Spherical; for a plain Triangle is made of three right Lines, and a Spherical of three arches of great Circles; but in this the three ſides are of three ſeveral kindes; namely, one ſide is an arch of the Meridian, and ſo of a great Circle, another an arch of a Parallel, and ſo of a leſſer Circle, the third ſide or *Hypthenuſal* being the Rumb, is no arch of a Circle, but a Segment of an Heliſpherical line.

But I anſwer, that notwithſtanding this may be Speculatively conceived, and ſo demonſtrated to be no Plain Triangle, yet in ſo ſmall Diſtances as theſe which here we uſe, there can be no ſenſible nor ſcarce any numerable difference. Yea, the diſtance between two parallels by the Rumb and Diſtance given (being the thing here chiefly aimed at) is very exactly found by this Rule, as before we have ſhewed, and as is more fully demonſtrated by Mr. *Wright*, in the 12 Chapter of his Book, *Of the Correction of Errours in Navigation*: Whence we may conclude, that the parts of the Meridian collected by this Table according to the Rumbs and Diſtances, as we have before ſhewed, do give the true meaſure of the Segment of that Meridian intercepted, between the Parallels of the two places propoſed.

## CHAP. IV.

*Of the difference of Longitude, Position and Distance of* York *and* London: *And how the Maps of* England *may by this Experiment be reformed, especially in the Latitude of Places.*

WE come next to speak of the Easterly and VVesterly distances gathered as before is shewed by these Tables, and to finde thereby the difference of Longitude, and of this we will give an Example in the fore-said Experiment: whereby we finde that the distance in Longitude, or the East and VVest distance between *York* and *London* is neer 14000 Poles, *London* being so much more Easterly then *York*. And before we have found that in a degree of the Meridian, and consequently in a degree of the Equinoctial there is neer 3709 $\frac{1}{10}$ Chains, at six Poles to the Chain, and this 14000 Poles converted into such Chains is 2333 $\frac{1}{3}$.

VVhich 2333 $\frac{1}{3}$ Chains (for finding the difference of Longitude) are not to be reckoned in the Parallel of *York*, that being too much Northerly, neither in the Parallel of *London*, being too much Southerly, but in a middle parallel between both, namely, about the Latitude of 52 degrees 45 minutes. Now to finde what difference of Longitude is answerable to this 2333 $\frac{1}{3}$ Chains in the parallel of 52 degrees 45 minutes, say

As *Radius* is in proportion
to Sine complement the Latitude *sc* 52 deg. 45 min. 9.78197
So is the measure of a deg. in the Equinoctial 3709 $\frac{1}{10}$ 3.56927
to the measure of a degree in that Parallel 2245 $\frac{1}{10}$ 3.35124

And

And thus we finde that in the Parallel, whose Latitude is 52 degrees 45 minutes, there are 2245 $\frac{1}{10}$ Chaines answering to a Degree, whereby it appears that the difference of Longitude between *York* and *London* is more then one degree, and to finde how much more, say again by the Rule of Proportion:

| | |
|---|---|
| As the measure of a degree 2245 $\frac{1}{10}$ *Co. ar.* | 6.64876 |
| Is to a degree in *Seconds*, 3600 | 3.55630 |
| So is the measure given, 2333 $\frac{1}{3}$ | 3.36797 |
| to the number of *Seconds*, 3741 | 3.57303 |

Which reduced, is 1 deg. 2 min 21 seconds, and thus we finde that *London* doth differ in Longitude from *York* 1 deg. 2 min. 21 seconds, being so much more Easterly.

Thus having the difference of Latitude, as also the difference of Longitude between these two places, we may (according to the second Problem of Sailing by *Mercators Chart*) finde the Rumb from *London* to *York*, to be 14 degrees 20 minutes from the North to the Westwards; that is, North by West 3 degrees 5 minutes Westerly, and the distance in that Rumbe 9442 Chains. But their distance in the High-way, by reason of the crookednesse and unevennesse of it, was more by about an eighth part.

And the like might be done for other intermediate Places between these, but effecting brevity we passe that over, as not much pertinent to our present purpose, onely expressing the Latitudes of some of the principal of them, as followeth.

| | *Latitudes.* |
|---|---|
| As the Latitude of *York*, we finde to be | 53 deg. 58 min. |
| *Doncaster* | 53 deg. 32 min. |
| *Newark* upon *Trent* | 53 deg. 5 min. |
| *Grantham* | 52 deg. 54 min. |
| *Stamford* | 52 deg. 38 min. |
| *Huntington* | 52 deg. 19 min. |
| *Royston* | 52 deg. 3 min. |
| *Ware* | 51 deg. 48 min. |
| *London* | 51 deg. 30 min. |

We

We further noted in this Experiment, that howſoever the number of Miles between *Ware* and *London* are almoſt the ſame by eſtimation that they are by meaſure; yet all the way beſides from *York* to *Ware*, a meaſured Mile conſiſting of 320 Poles is but three quarters of a Mile, as the miles lie by eſtimation or common account; ſo that every where (for the moſt part) three miles by eſtimation make four meaſured miles. And a minute or the ſixtieth part of a Degree, is almoſt in the middle between them both: So that look how much a meaſured Mile is leſſe then a minute, ſo much or ſomewhat more is a mile by eſtimation greater then a minute; for as there is contained in a Degree of meaſured Miles $69\frac{1}{2}$ and ſomewhat more, as we have before ſhewed, ſo of our common eſtimated Miles, there are contained about $51\frac{2}{3}$ in a Degree.

Upon theſe grounds the whole Map of this Kingdome might be much rectified, eſpecially in the Latitude of Places; for though we cannot hence determine certainly the Latitudes of any other places beſides thoſe which were in the way, or at leaſt in ſight as we came up (the principal of which we have before noted.) Yet we may neerly conjecture the Latitudes of moſt parts of *England*, by their Diſtances and Poſitions from theſe; but theſe things being beſides our ſcope and purpoſe in this place, we we ſhall onely compare the latitude of ſome principal places, probably gathered from this Experiment, with the latitudes of the ſame places, as they are ſet down by Mr. *Speed* in his *Geographical* Deſcriptions of *England*; that ſuch as pleaſe to examine both in any particulars, may know to which they may more ſafely lean.

---

*Canter-*

| | Latit. by this Exper. | Latit. by M. *Sp.* map | | Latit. by this Exp. | Latit. by Mr. *Sp.* map |
|---|---|---|---|---|---|
| | D. M. | D. M. | | D. M. | D. M |
| *Canterbury* | 51 17 | 51 29 | *Northampton* | 52 14 | 52 36 |
| *Chicheſter* | 50 48 | 50 51 | *Huntington* | 52 19 | 52 44 |
| *Guilford* | 51 12 | 51 22 | *Stamford* | 52 38 | 53 04 |
| *Wincheſter* | 51 03 | 51 11 | *Leiceſter* | 52 40 | 53 06 |
| *Dorcheſter* | 50 40 | 50 44 | *Lincolne* | 53 14 | 53 50 |
| *Exceſter* | 50 43 | 50 48 | *Newark* upon *Trent* | 53 05 | 53 38 |
| *Wells* | 51 12 | 51 22 | *Nottingham* | 53 00 | 53 32 |
| *Salisbury* | 51 04 | 51 12 | *Darby* | 52 58 | 53 30 |
| *Reading* | 51 28 | 51 42 | *Stafford* | 52 52 | 53 22 |
| *London* | 51 30 | 51 45 | *Shrewsbury* | 52 47 | 53 16 |
| *Colcheſter* | 51 58 | 52 16 | *Cheſter* | 53 16 | 53 52 |
| *Ipſwich* | 52 08 | 52 30 | *Lancaſter* | 54 10 | 54 57 |
| *Norwich* | 52 42 | 53 10 | *York* | 53 58 | 54 44 |
| *Cambridge* | 52 12 | 52 32 | *Richmond* in *Yorkeſhire.* | 54 28 | 55 18 |
| *Hertford* | 51 49 | 52 06 | *Kingſtone* upon *Hull.* | 53 48 | 54 29 |
| *Bedford* | 52 08 | 52 30 | *Doncaſter* | 53 32 | 54 12 |
| *Buckingham.* | 52 00 | 52 20 | *Durham* | 54 50 | 55 45 |
| *Royſton* | 52 04 | 52 24 | *Carlile* | 55 00 | 55 56 |
| *Oxford* | 51 46 | 52 02 | *Newcaſtle* | 55 03 | 56 01 |
| *Gloceſter* | 51 53 | 52 11 | *Barwick* | 55 54 | 57 03 |
| *Hereford* | 52 07 | 52 27 | | | |
| *Worceſter* | 52 14 | 52 36 | | | |
| *Warwick.* | 52 20 | 52 45 | | | |

* The Latitudes of theſe Places in the firſt Column expreſſed, are ſuch as are probably gathered from this Experiment. But in

in the second Column, there is set down the Latitudes of some places, as they are expressed by Mr. *John Speed* in his Map of *England*, set forth in his Book, entituled *The Theatre of the Empire of great Brittain*, and least there should be any mistake in his Map, I have conferred these Latitudes thence gathered with the Latitudes of the same Places set down by him in words at large, in his descriptions of each several County, and finde them neerly to agree, except in the Latitude of *Berwick*, which in his Map he makes to be 57 degrees 03 minutes, but in his Historical Descriptions of *Northumberland*, he relates it to be 55 degrees 48 minutes, which last is much neerer the truth, but seems not to be his meaning; because then he should make it more Southerly then *Newcastle*, yea more Southerly then he doth *Carlile*, which by his Map, and also by his words in his Relation of *Cumberland* is in the Latitude of 55 degrees 56 minutes. VVhereas *Berwick* is above 50 miles more Northerly.

By these you may neerly conjecture the Latitude of other parts of *England*, lying in or neer the same Parallel with any of them: And hence also it appears, that the difference of Latitude between *Berwick* and the South-coast of *England* neer *Christ-Church*, is little more then 5 degrees, not 6 degrees and more, as some of our Maps make it. But these things we must leave, that we may proceed to that which is principally intended, onely we will first touch a little upon the use of the fore-going Table in Plotting and Surveying of Land.

CHAP.

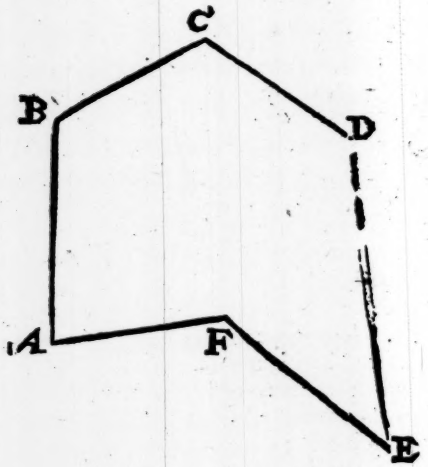
## CHAP. V.

*To Delineate the Plot of any Forreſt, Park, Common, or other piece of Ground; as alſo of Rivers, Harbours, &c. ſpeedily and moſt exactly.*

MY intent is not here to proſecute at large the Plotting of Grounds, being a thing handled by others, treating of Surveying: But conſidering that the wayes by them directed and by others practiſed, in delineating or laying down the Diſtances and Angles obſerved by the *Circumferentor*, *Theodolite*, *Peractor*, or other graduated Inſtrument is by a *Protractor*, and that the Table before-going, or that which followeth towards the end of this Treatiſe, ſerveth for that and the like purpoſes almoſt as ſpeedily, and farre more exactly, I ſhall crave leave to digreſſe a little to ſhew this uſe of it as briefly as I may. Therefore paſſing over the method to be uſed in ſetting down the Names of the Grounds, the Tenants, Borderers, and other remarkable things, and leaving every man in theſe to the wayes whereunto he is accuſtomed You may (as ſometimes I doe) make a Book in a long *Octavo*, and upon the left ſide thereof ſet down ſuch things, as theſe before mentioned, reſerving every right ſide, and dividing them by Ruled Lines into ſix Columnes, as hereafter following appeareth.

And having taken and ſet down your Notes in the Field on the left ſides or pages of your Book, you may in the Evening or next morning before you go out, or when elſe your occaſions will permit, ſet down in the firſt Columns on the right ſide, how many Degrees the Lines upon which you have traverſed, are diſtant from the North or South part of the Meridian towards the Eaſt or Weſt, and in the ſecond Columns the quantity of the ſame Lines in Changes, Chaines, and ſingle Poles, and parts of Poles.

As in this Figure, ſuppoſe the Line from A to B to be directly Eaſt ſeven Changes, that is, ſeven times 30 Poles, or 210 Poles, from B to C to the Eaſtwards of the South 35 degrees, 5 Changes, and one Chain; from C to D, to the Weſtwards of the




South 32 degrees, five Changes, and four Chains, from D to E, to the Weſtwards of the South 80 degrees, ten Changes; from E to F, to the Eaſtwards of the North 35 deg. ſix Changes, three Chains, and two thirds of a Pole. And laſtly, from F to A, the place where I firſt began to the Weſtwards of the North 9 deg. 5 Changes 3 Chains, $2\frac{1}{3}$ Poles: All theſe I expreſſe in the firſt and ſecond columns on the right ſide, as hereafter following appeareth.

Which done, I take the Table, and finde there the Northing and Southing, Eaſting or Weſting anſwerable to theſe Degrees and Diſtances, and ſet them down accordingly. As for the firſt being Eaſt ſeven Changes, I ſet down in the Eaſt columne 210

Poles

Poles with a Cipher behinde it. For the ſecond being *S E*, 35 deg. I finde in the Table for 5 Changes 1228, to be ſet in the South Column, and 860 for the Eaſt Column: alſo upon the ſame degree for 1 Chaine 25 for the South Column, and 17 for the Eaſt Column: And ſo I proceed with all the reſt, untill I have finiſhed.

| *Deg.* | | *Diſt.* | *North.* | *South.* | *Eaſt.* | *Weſt* |
|---|---|---|---|---|---|---|
| *Eaſt.* | | 0 | | | 2100 | |
| *S E.* | 35 | 2 | | 1228 | 0860 | |
| | | | | 0025 | 0017 | |
| *S W* | 32 | 4 | | 1272 | | 0795 |
| | | | | 0102 | | 0064 |
| *S W* | 80 | 0 | | 0521 | | 2954 |
| *N E* | 35 | 3 | 1474 | | | |
| | | 2 | 0079 | | 1032 | |
| | | 3 | 0005 | | 0052 | |
| | | | | | 0004 | |
| *N W* | 09 | 3 | 1481 | | | 0234 |
| | | | 0089 | | | 0014 |
| | | 2 1/2 | 0025 | | | 0004 |
| | | | 3148 | 3148 | 4065 | 4065 |

And being thus returned to my firſt Station, I ſumme up ſeverally theſe four Columns of North, South, Eaſt and Weſt; and finding that the ſumme of the North column is equal to that of the South, and the ſumme of the Eaſt is equal to that of the Weſt. I conclude the whole VVork to be truly performed, whereas if there had been any difference, it had ſhewed an Errour, and if that difference had been great, it had been neceſſary to examine the work again, and ſo to correct it.

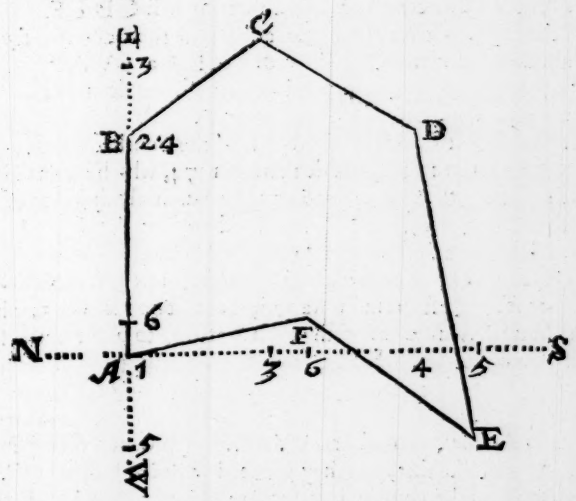
It is usual to adde together all the angles, and also to multiply two right angles, or 180 degrees by the number of angles lacking two, and if the summe of the angles added together be equal to this Product, the Work is thought to be true: as here, if we adde the inclinations and reclinations of these Lines in this Figure, the sum is 720 deg. or eight right angles, and if we multiply two right angles by 4, (because here are six angles) the Product is also eight right angles. But the other by the summes of the Columnes, is a most absolute way for examining the truth of your work, and to be preferred before any other that I know.

It may seem very laborious to set down every Station in this manner, but one that is a little exercised in it may, as I take it (for I never observed the time exactly) set down 40 or 50 Stations in this manner, within the space of an hour, or thereabouts; but I should advise that it be done by two men, having each a Table for that purpose to avoid all mistakings.

If your Instrument give not the angle with the Meridian expressly, yet it may easily be gathered thence, or else you may divide a Circle as your Instrument is divided, and number the Degrees as they are there numbred, which done, number them also from the North and South part of the Meridian towards the East and West, so shall you easily know the angle of any Degree with the Meridian.

Now to proceed, these Measures may be set down in a Plot several wayes. As first, considering which way the Ground lies, I take a point for my first Station, so as the whole may fall conveniently within the plot, which let be the point A, by which point I draw a Meridian and parallel, namely two right lines intersecting one another at right angles: whereof let *N S* be the Meridian running North and South, and *E W* the parallel running East and West; this done, I look to the North and South Columns, and there first in the South Columne, and against the the third Station, I finde 1253, that is, 125 $\frac{3}{0}$ Poles; this I set in the Meridian from A, to the Southwards, and mark the point with the figure 3, then in the South Column against the fourth Station,

Station, I finde 1374, which I ſet in the Meridian from 3 to 4; alſo againſt the firſt Station I finde 521, which I ſet in the Meridian from 4 to 5. Then againſt the ſixt Station, I finde in the North collumn 1553, which I ſet in the Meridian from 5 to 6: alſo againſt the ſeventh Station, which is the ſame with the firſt, I finde 1595, which I ſet in the Meridian from 6, and it falls upon A, which is the firſt Station: and thus I have done with the South and North columns.




In like ſort I expreſſe the meaſures in the East and Weſt Collumns in the Parallel E W. As finding firſt in the East Column 2100, I ſet it down from A to the Eaſtwards, and it extends to B, where I ſet 2, ſignifying my ſecond Station; I finde next in the East Column 877, which I ſet in that Parallel from 2 to 3, next in the Weſt Column 859, which I ſet in that Parallel from 3 to 4; and ſo I proceed with the reſt. And having thus ſet down the meaſures in the Meridian and Parallel, we have alſo as it falls out in this Example two Stations expreſt, namely A and B

now

now for the third, I take in the Parallel with my Compasses the distance A 3, and setting one foot in the Meridian at 3, I strike an arch neer C; also taking in the Meridian the distance A 3, and fixing one foot in the parallel at 3, I crosse the aforesaid arch neer C, the intersection of these two arches is the point C, representing the third Station.

In like sort, I proceed to finde the points D E F for the fourth fifth, and sixth Stations, then drawing Lines, namely from the first Station A to the second B, and from the second to the third C &c. We shall describe the Figure requird A B C D E F.

Otherwise, whereas here you adde and substract the several distances of South and North, as also of East and VVest by your Compasses; you may with a little more pains adde and substract them by the Pen, which is the better way.

As having set down in the Meridian the Southerly distance of the third Station 1253, I adde thereto 1374, which is against the fourth Station, the summe is 2627; the Southerly distance of the fourth Station, which I set in the Meridian from A to 4. Again, to this I adde 521, so have I 3148, the Southerly distance of the fifth Station A 5, from which substracting 1553, the Northerly distance set against the sixth Station, there remains 1595, which is the Southerly distance of the sixth Station, to be set in the Meridian from A to six. Lastly, from this, abating the Northerly distance of the first Station from the sixth, which I finde there also to be 1595, there remains 0. Shewing that I am returned to the same Parallel, or East and VVest line, in which at first I began. And in like sort, you may proceed with the East and VVest columnes, and then by the intersection of two arches, finde every Station, as before.

Other wayes might be prescribed, which will not be hard to finde of your self. And as we may thus lay down any irregular right-lined Figure far more exactly then by the *Protractor*: So when it is laid down after this manner, we may cast up the *Area* or Superficiall quantity of it very exquisitely: Yea, if there should be a Plot drawne (according to the Angles and Distances here given) after the usuall manner by a Scale:

Scale ſo large, that the Plot ſhould be an hundred times ſo great as this; Yet could not the content thereof be caſt up ſo exactly and certainly as it may be here.

But I muſt not inſiſt upon theſe things, they may of themſelves be conceived, and mine intent is onely to touch them, that I be not prevented of time, and by other occaſions from handling thoſe things which I have here more ſpecially intended.

But as I have ſaid, this courſe is chiefly to be uſed in plotting large grounds, and there indeed are graduated Inſtruments, eſpecially to be uſed: for other ſmaller grounds, there is none more fit then the *Plain Table.*

## CHAP. VI.

### *Of the Compaſſe of the Earth, and the quantity of a Degree, according to the moſt approved Experiments; Ancient and Modern.*

ALthough the Compaſſe of the Earth hath been in ſome ſort obſerved by divers of the Ancients: Yet for ſome of them we cannot certainly gather what Meaſures they uſed; others uſed no Meaſure at all, but aſſumed the Diſtance of Places to be ſuch as it was eſtimated by Travailers to be, and likewiſe the Latitude; therefore it will be needleſſe to inſiſt upon the examination of their Obſervations, others of them which were taken by meaſure, and which we may upon any good Ground reduce to our Meaſures, are theſe which follow.

*Willebrordus Snellius* in his Book entituled *Eratoſthenes Batavus*, cites *Abel Fedas*, a moſt diligent Arabian-Geographer, that lived about the year of Chriſt 1222, who records, that about

about the year of Christ 827, certain men skilful in the *Mathematicks*, did by the commandment of their Prince *Almamon*, measure in the fields of *Mesopotamia* (as he gathers) under one and the same Meridian, from the North towards the South, the quantity of a degree, and found it to be 56 Miles or somewhat more. The quantity of their mile, according to *Alphragranus*, was 4000 Cubits, or 6000 Feet: whence the quantity of a degree should be 336000 Feet, but of the length of their Feet we are something uncertain, onely they define it to be so long as the extent of 96 barley-cornes laid side by side; whereas the *Rhyniand*-Foot, according to trial by him made, is but the extent of 90 cornes laid in like manner, so that if there be no inequality in the grains, then 90 *Arabian*-Feet are equal to 96 *Rhyniand*-feet. But 96 *Rhyniand*-feet are found to be about $99\frac{1}{7}$ *English*-feet, therefore also, by the rule of Proportion, 336000 *Arabian*-feet doe make of our *English*-feet 370222, So that according to this experiment of the *Arabians*, a Degree should containe 370222 of our *English*-feet. And before we have found by the Observations taken at *London* and *Yorke*, and by the distance of their parallels measured, that a Degree contains of our *English*-feet 367200. The difference is onely 3022 feet, that is about the $\frac{1}{120}$ part of a Degree or halfe a minute.

He cites next *Alhazen* the *Arabian*, who in his Book *de Crepusculis*, declares the compasse of the Earth to be 24000000 Paces, so that proportionally there must be in one degree $66666\frac{2}{3}$ paces, that is 333333 Arabian-feet. And seeing that 90 Arabian feet make of our English feet $99\frac{1}{7}$, therefore by the Rule of Proportion 333333 Arabian-Feet, make of our English feet 367283: So that according to *Alhazen*, there should be in a Degree 367283 of our English-Feet differing from the Experiment which I made onely 83 feet in a Degree.

I have not strained these numbers to bring them to this neernesse, they are the same in effect which are set down by *Snellius* in his *Eratosthenes Batavus*, who with great industry and judgment hath compared the Measures of the Ancients, and the measures used by several Nations in these times, with the

*Rhyn-*

*Rhyniand*-foot. Much leſſe have I ſtrained mine own numbers to draw them up to theſe: But on the contrary, I confeſſe upon the ſight of his Book, obſerving the great paines and induſtry which he profeſſeth himſelf to have beſtowed, and which I doubt not but he did imploy in making his Experiment, and how he had found the meaſure of a degree to be much leſſe then mine, as we ſhall after ſhew, I began to doubt that I had not made ſufficient allowance for the unevenneſſe of the wayes, and for ſome ſmall bendings, ſometimes to the right hand, ſometimes to the left, the obſervation whereof I wittingly neglected to ſpare time and expence. For I did often obſerve a mile or two before me, ſome mark in the High-way noting the degree, and meaſuring to it in the way, neglecting to obſerve the intermediate ſwervings of the way, ſometimes three or four degrees towards the right hand, ſometimes as much to the left, but making ſuch allowance for that, and for the unevenneſſe as I judged ſufficient. And ſome men may think, that the exact Obſervation of theſe leſſer things thus neglected and regulated onely by judgement or conjecture might deceive me much: But they may conſider, that if there be two places a mile diſtant, that is, in a right line 320 Poles, if you meaſure from one of theſe places towards the other, not in that right line, but alwayes ſwerving from it by an angle of 4 degrees, ſometimes to the right hand, ſometimes to the left, till you come to that other place; I ſay, that notwithſtanding all theſe ſwervings (if there be nothing elſe to augment the meaſure) it will not amount to 321. Now conſidering that I had all the way, as occaſion required, made ſuch allowance as ſeemed convenient, and ſo found 367200 Feet in a degree, before I compared it with the meaſures taken by any other: I reſolved not to diminiſh nor to augment the number thus ariſing by my Obſervations, Meaſures, and Allowances, in reſpect of the Opinions, Obſervations, or Meaſures of any other man, untill there be made ſome Experiment more evident and exact then any yet extant. And I am ſomething the more confirmed by the neer agreement of theſe two teſtimonies before recited, both exceeding me a little in the meaſure of a degree. But we cannot con-

ſedently reſt upon them, becauſe of that inequality which may be of Cornes or Grains; for theirs may haply be ſomething greater or leſſer then ours.

Both theſe meaſures of a Degree do much exceed the quantity of a Degree found by *Snellius*, but when he compares them with his own another way, namely, placing the Barley-cornes ſo that they may not lie flat, but be ſet up edge-wiſe, and ſo by 96 Cornes to make a Foot, and by ſuch feet to meaſure a Degree; then he findes that the quantity of a Degree according to the *Arabians* is much leſſe then by his Experiment it ſhould be: but if ſome be laid flat, and others ſet up edge-wiſe, the *Arabian* meaſure of a Degree will agree with his. And ſo he propoſeth this doubt, whether the 96 grains whereof the *Arabian* foote doth conſiſt, muſt lie flat or be ſet up edge-wiſe, or ſome of them to lie flat, and others to be ſet up edge-wiſe. But it is moſt probable that they muſt he flat, that being the poſition which they are apt unto by nature; they cannot be ſet edge-wiſe without much trouble, eſpecially ſo many together as make the length of a foot, and ſo the *Arabian* meaſure of a Degree doth neerly agree to this of mine.

VVe come next to hear the determination of *Ptolomy* of *Alexandria*, whoſe authority and credit in the ſolution of this queſtion is not inferiour to any of the Ancients. He affirms the compaſſe of the Earth to be 180000 *Stadiums*, and the quantity of a Degree 500 *Stadiums*; the ſame (as *Strabo* ſaith in his 2 Book of *Geography*) was before affirmed by *Poſidonius*. Alſo *Marinus Tyrius* (before *Ptolomy*) had determined the quantity of a Degree to be 500 *Stadiums*. *Ptolomy* confirms it, not ſimply from their Relations, but as it ſeems from his own experience, and that by ſome meaſures diligently taken, for in the 11. Chapter of the firſt Book of his Geography, he hath theſe words; *Sed in hoc quoque rectè ſentit, partem unam qualium eſt circulus maximus trecentorum ſexaginta; quingenta in terra conſtituere Stadia, id enim confectis dimenſionibus conſonum exiſtit.* Alſo *lib. 7. cap. 5. Ita ut pars una, ſeu gradus unus quingenta contineat Stadia, quemadmodum ex diligentibus deprehenſum*

*sunt est dimensionibus.* Now a Stadium not onely amongst the *Greeks*, but as appears by *Herodotus* amongst all other Nations of *Asia*, and in *Egypt*, did consist of 600 feet; therefore a Degree according to *Ptolemy*, must contain 300000 feet. But the *Egyptian* or *Alexandrian-foot* was much greater then our foot; for as we have before said, the ancient *Roman*-foot is greater then ours, and the *Egyptian-foot* was much greater then the *Roman*: For it is often testified by *Hero Mechanicus*, that five *Alexandrian* feet make six *Roman* feet. And Mr. *Snellius* hath very ingeniously gathered both from *Philandes* and otherwise, that the *Rhyland*-foot is equal to the ancient *Roman*-foot; therefore also five *Alexandrian* feet are equal to six *Rhyland* feet: So that by the Rule of proportion, 300,000 *Alexandrian* feet will make of *Rhyland* feet 360000. But by the size of our *English* foot, which was sent him from the Iron Standard in *Guild-hall*, he findes it to contain but 968 such parts as the *Rhyland* contains 1000: So that 968 *Rhyland* feet are equal to 1000 *English*, or 121 *Rhyland* feet are equal to 125 *English* feet. Therefore also by the Rule of proportion, 360000 *Rhyland* feet are equal to 371900 of our *English* feet. Therefore according to *Ptolomy*, there are contained in a Degree 371900 of our English feet. But by our fore-mentioned Experiment made between *York* and *London*, we finde onely 367200 feet in a Degree, being lesse then *Ptolomies* by 4700 feet, that is, by $\frac{1}{10}$ part of a Degree, or $\frac{1}{4}$ of a Minute, and little more.

*Fernelius* a modern Authour and learned Physician, measuring the way by the Revolutions of a Wheel, and the Latitudes by Observation, finds in a Degree 68 *Italian* miles, and 96 paces, the Pace which he used being more then five of our *English* feet: But because he handled not the Probleme exactly, and is suspected by *Snellius*, (though I think without cause) to have grounded his Conclusion rather upon the Experiment of the *Arabians* before set down (wherewith it doth neerly agree) then upon his own, we will insist no longer upon it.

We come in the last place to the Experiment of *Willebrordus Snellius*, a *Hollander*, made in the *Netherlands* about 20 years

past. We shall not need to recite the particulars of it, being extant at large in his Book before-mentioned, but in Conclusion he findes in a Degree 342000 *Rhynland*-feet. Now a *Rhynland*-foot (as he hath there shewed, comparing both together) is greater then ours, and that in such Proportion, as 1000 is to 968, (and so much or little more it appears to be by that Model of the *Rhynland* foot printed in his Book) therefore 968 *Rhynland* feet must make 1000 of ours; and hence by the Rule of Proportion, 342000 *Rhynland* feet will make of our English feet 353306. So that there should be in a Degree onely 353306 feet, which is lesse then we have before found in a Degree, by 13894 feet, that is, by $\frac{1}{25}$ part of a Degree, or $2\frac{1}{4}$ Minutes, and something more. He was a man doubtlesse of singular industry and knowledge, and of much exercise in the Mathematicks, and it may be, was well experienc'd in this particular, touching the Geometrical mensuration of Distances, and he hath bestowed much pains and diligence in this Experiment, as by his Book appeareth. But if he had by a Chain measured the Distance of his two utmost Stations (if the ground would permit, which I suppose it would not) or at least-wise if his measured Stations had been further distant: I conceive he would have found a greater Distance in his two utmost places of Observation. But if a man intending to finde the Distance of two places, measure onely the $\frac{1}{100}$ part of that Distance, and by that measured Line and the angles, think to finde their true Distance; whether he do it immediately from those two measured Stations, or mediately by help of others observed from them, he may easily fall into some notable errour. For though the Probleme be exactly true in Geometrical Demonstrations, how small soever the measure be, yet it is not so in sensible and experimental practises, by reason of the weaknesse even of the best eye, and the imperfection of the Instruments in themselves, and in their use. And besides that, there were many Stations obliquely scituate; A man cannot alwayes hit the just middle of that Turret, Steeple, or other mark which he observes: Neither when he comes to make his Station there, can he always place his Instrument just at the concourse of his former

mer visual Lines, by reason of other impediments. Besides the force of the VVinde in such eminent places: and moreover that amongst so many Steeples, as there are in some Townes there, a man may at sometime mistake one for another. And if there should happen no notable Errour, by reason of any or of all these Casualties; Yet may two minutes in the difference of the Latitude of two places be easily mistaken, especially being derived from the Latitudes of those places which are very rarely set down true to a minute.

If it be objected, that I might aswell be so much mistaken in the difference of the Latitudes of *York* and *London*.

I answer, it is not so likely, because I had the opportunity of observing the Summer Solstitial Altitude of the Sun in both places, wherein I had no necessary use of the Suns Parallax nor Refraction, nor of the Table of the Suns Declination, any of which may cause more then a minutes errour, in finding the Latitude of either place.

Besides, if mine Errour in those Observations should be full as much, yet would it not in the Conclusion be half so much, because the difference in Latitude of the two places of mine Observation is more then twice so much as that of his.

But let this suffice, leaving every man to imbrace that which he shall best approve. Both our Experiments do sufficiently convince that common errour of counting onely 300000 *English* feet to a Degree, besides the consent of other Observations before recited ancient and modern.

Mr. *Snellius* hath further in that Book of his, entituled *Eratosthenes Batavus*, with much diligence compared some ancient Measures, as also the measures of sundry Forreign-Countreys with the *Rhynland*-foot; and amongst the rest our *English*-foot, according to a size thereof to him sent from the *Standard* in *Guild-Hall*, (from whence also I had about twenty years past the size of that Foot which I have used in this measure) we shall not need to repeat them all, because his Book is extant: some of them are these following, which we here compared to our *English*-foot, as he hath there done to the *Rhynland*, that so any of them

them may the more eaſily be reduced into our Feet. Therefore dividing the *Engliſh foot* into 1000 equal parts, we ſhew how many of thoſe parts are contained in other ancient & forreign feet.

Ancient feet compared with our *Engliſh-foot.*

| | | |
|---|---|---|
| Of ſuch parts as the *Engliſh foot* contains | | 1000 |
| The | Ancient *Roman-foot* contains | 1033 |
| | Ancient *Greek-foot* contains | 1076 |
| | *Babylonian* contains | 1211 |
| | *Alexandrian* contains | 1240 |
| | *Antiochean* contains | 1405 |
| | *Arabian* contains. | 1102 |

Forreign feet compared with our Engliſh.

| | | |
|---|---|---|
| Of ſuch parts as the *Engliſh*-foot contains | | 1000 |
| The | *Rhynland*-foot contains | 1033 |
| | *Dort*-foot contains | 1085 |
| | *Middleburge*-foot contains | 992 |
| | *Amſterdam*-foot contains | 934 |
| | *Antwerp*-foot contains | 939 |
| | *Lovain*-foot contains | 939 |
| | *Hafnian*-foot in *Denmark* | 965 |
| | *Paris*-foot called the *Kings*-foot | 1090 |
| | *Venice*-foot | 1157 |
| | *Toledo*-foot | 896 |
| | *Nuriberg*-foot | 1006 |
| | *Strasburg*-foot | 920 |

## CHAP. VII.

### *Of dividing the Log-line, and reckoning the Ships way.*

THere be foure things, upon which the Practice of Navigation is eſpecially grounded; namely, the knowledge of the Longitude, Latitude, Courſe, and Diſtance. Touching the Longitude, though it may be found by the other three, yet hitherto there hath not been delivered any general Rule true and practicable, whereby the Longitudes

gitudes of places might be immediately and ordinarily found of themselves. The Latitudes of Places may immediately be found by Observation of the Sun and Starres, as we have formerly shewed in the Appendix to the Doctrine of Triangles: The Course by the Compasse, the Variation being duely observed, wherein we have many good Mariners very expert, this we have also handled in the Doctrine of Spherical Triangles. The Distance run is found of it self by the *Log-line*, whereof we are here to speak.

The ground of finding the Distance runne by the *Log-line* is meerly conjectural, being founded upon this opinion, that five of our feet make a pace, and a thousand such paces make a Mile, and that 60 such Miles make a Degree; so that a Degree should contain 300000 of our feet. But it appears not onely by this Experiment, but even by all others that were diligently taken and their measures to us known, that there is a greater number of our feet contained in a Degree.

There be three things (as I conceive) that have caused this Errour to be so commonly received and tolerated. The one, for that it doth somewhat counterpoize another contrary errour in the Practice of *Navigation*, namely in the use of the *Plain chart*, for the Errour which is there committed by making every parallel equal to the Equinoctial, and so every degree in them greater then they should be, is something moderated by this errour, whereby the measure of a Degree is esteemed lesse then indeed it is.

For instance; It is evident by the *Globe*, that the Meridians concurring in the Poles grow neerer and neerer together, as they grow towards the Poles: insomuch as if two Meridians be distant in the Equinoctial ten degrees, that is 600 miles, the same Meridians in the Latitude of 35 deg. will be distant little more then 490 miles. Now if unto every mile we account according to the former experiment 6120 feet, then is the distance of those two Meridians in that parallel neer 3000000 feet. In like sort in the *Plain-chart* ten degrees of that parallel (as of all others) is made equal to tenne degrees of the Equinoctial or Meridian:

so

ſo that the diſtance of theſe two Meridians will upon the *Plain Chart* be 60 miles, but one of theſe miles contains onely 5000 feet, ſo that the diſtance is but 3000000 feet, equal to the former.

And although theſe errours in other caſes do not juſtly ballance one another as in this example, yet that of the *plain Chart* is alwayes ſomething moderated by this other, and ſo much the more by how much they are neerer to the foreſaid Latitude. I grant that this is onely ſo, when the courſe is neer unto the Eaſt or Weſt points; but withall, I ſay that this kinde of reckoning is (in a manner) then onely uſed: For he that runs any courſe neer the Meridian Southerly or Northerly, hath a more certain way of reckoning; namely, his Latitude which he findes daily by Obſervation of the Sun and Starres, upon which he will depend, either neglecting or at leaſt not regarding his dead reckoning. Yea, (it may be) never caſting the *Log* ſo much as once in ſuch a voyage, having a more ſure ground for his reckoning. But in a Courſe that is neer Eaſt and Weſt (foraſmuch as there is no way diſcovered for finding the Longitude) he is driven of neceſſity to make uſe of his dead reckoning.

VVe might adde moreover, that the principal Voyages of this kinde, I mean of thoſe which conſiſt of Courſes much Eaſterly and VVeſterly, as to and from the *Weſt-Indies*, and the Parallel of *Cape bon Eſperance* are neer unto this Latitude of 35 degrees; ſo that as ſome of them are more Southerly, others of them are more Northerly.

But to inſiſt no longer upon this, I ſuppoſe a ſecond cauſe to be, for that men commonly deſire to have their reckoning before their Ship (as they ſay) that they fall not with a place before they look for it; And this comes ſo to paſſe, whileſt the miles are accounted leſſe in meaſure, and ſo more in number then they are indeed.

And thus, though there may ſeem to be ſome commodity in theſe errours, eſpecially when they do neerly ballance one another: Yet becauſe they ſeldome do ſo, but alwayes leave men in uncertainties, and oftentimes in great perplexity and danger,

it

it is much safer and better to reject them both, and to imbrace those ways, which are evidently grounded upon truth, though there may be in them some more difficulty at the first. Yet I confesse, that he which reformes one and not another, may sometimes erre so much the more thereby. And I doubt not, but many would reform them both, if they could certainly do so.

Therefore a third cause of admitting and retaining this Errour seems to be, for that there hath been no way delivered from evident and certain grounds, for the rectifying of it. I doubt not but many have found Errours in their reckonings arising from hence, that they account onely 300000 of our feet to a Degree; but not knowing certainly where to lay the fault, have imputed it sometimes to ill steerage, otherwhiles to the Variation of the Needle, or to some mistake in their Reckoning, or to some errour in their Plots, or to some Current, or such other accident, and so the Errour hath rested un-reformed. Wherefore although the practical performance of this Probleme for finding the Circumference of the Earth, or the quantity of a Degree on the same have many singular uses which I cannot now touch; yet that which amongst the rest I chiefly aimed at, was that we might have a more sure and evident ground for dividing the *Log-line*, and for reckoning the ships way or distance run more truly upon any Rumbe or point of the Compasse then formerly.

And now to apply it to this purpose, we have noted before (*Chap.* 2.) that by the Experiment there expressed, we finde in a Degree on the circumference of Earth and Sea, 367200 of our English feet. Wherefore retaining still the same division of a Degree into 60 miles or 20 leagues (as hath been formerly used) a Mile will contain 6120 Feet, or 1020 Fathomes: And so a League contains 18360 feet, or 3060 Fathomes; for dividing 367200 by 60, the quotient is 6120, &c. Thus then 60 miles being a Degree, every mile is 6120 feet.

Now supposing the time of the running out of the *Log-line*, to be measured by an half-minute glasse, if we observe how many feet or fathom she runs in half a minute; we may thereby finde her way for an hour or four hours, or for any other time proposed.

As admit there runnes out of the *Log-line* in half a minutes ſpace 51 Feet, or 8½ Fathoms, and you would know what way the ſhip makes every hour after the ſame rate;

Say by the Rule of Proportion;

If o½ Minute, give 51 Feet,

VVhat gives 60 Minutes, Or,

If 1 Minete give 102 Feet:

VVhat gives 60 Minutes?

And ſo multiplying, you ſhall finde 6120 Feet, which is one mile. Or if you would finde her way for four hours, which is 240 minutes; ſay,

As 1 minute is in proportion to 240 minutes,

So are 102 Feet, to 24480 feet, or 4 miles.

Or if you would have it in Fathomes; ſay,

As 1 minute is in proportion to 240 minutes,

So is 17 Fathomes, to 4080 Fathomes, the ſhips way in four houres. The like is to be conceved, if your Glaſſe be for any other quantity of time above or under half a minute.

Some have thought that the way which the ſhip maketh, may be known to arnold Sea-man by experience (as they ſay) that is by conjecture: VVhich opinion makes ſome neglect the uſe of the *Log*, leſt they ſhould be accounted young Sea-men. But as he that rides often will have ſome neer gueſſe how farre the Pace he rides will carry him in an houre (becauſe he hath often obſerved it formerly) ſo he which hath often ſailed and kept an account of the ſhips way by the Log, will be able to give ſome neer eſtimate of her way without the Log. But it is incident to ſome men to have ſuch a conceit of this their eſtimate, that they think it more certain then the Rule it ſelf, from whence it is derived, eſpecially if it chance to anſwer their expectations at ſome times.

It is thought alſo, that the ſhips way may be knowne by two marks on the ſhips ſide, but this is doubtleſſe very uncertain, both by reaſon of the ſhortneſſe of the time, and in reſpect of the dead water (as they call it) by the ſhips ſide. For the water which is neer the ſhip, is drawn along with the ſhip in her motion,

motion, and ſo much the more, by how it is neerer.

But if any deſire to make trial of this way, it is to be conſidered, that 17 foot is $\frac{1}{360}$ part of a mile, and 10 *ſec.* of a minute is $\frac{1}{360}$ part of an hour: therefore if there be two marks on the ſhip ſide diſtant 17 feet, if the ſhip run the diſtance of theſe two marks in 10 ſeconds, ſhe runs a mile an hour, if in 5 ſec. two miles an hour, if ſhe run that diſtance in 2 *ſec.* ſhe runs 5 miles an hour. And ſo alwayes dividing 10 *ſec.* by the number of *ſeconds*, in which the ſhip runs that diſtance, the quotient ſhews the miles and parts of a mile run in an hour.

But if the Diſtance of thoſe two marks be 34 feet, if ſhe run it in 20 ſeconds, it is after a mile an hour, if in 10 *ſeconds*, two miles an hour, if in 5 *ſec.* four miles an hour: And ſo alwayes dividing 20 *ſec.* by the number of *ſec.* in which the ſhip runs that diſtance, the quotient ſhews how many miles the ſhip runs in an hour. As if the ſhip run that diſtance of 34 feet in 8 *ſeconds*, then dividing 20 by 8, the quotient is $2\frac{1}{2}$, ſhewing that ſhe runs $2\frac{1}{2}$ miles in an hour. Or, if you can conveniently make the diſtance of the two marks on the ſhips ſide to be 51 feet (for the further they are diſtant, the better) then if the ſhip run that diſtance in 30 *ſec.* it is a mile an hour, if in 10 *ſec.* it is 3 miles an hour, and ſo alwayes dividing 30 *ſec.* by the number of *ſeconds* in which the ſhip is running that diſtance, the quotient ſhewes after that rate how many miles the ſhip runs in an hour.

Otherwiſe you may do thus, divide 17 feet into 10 parts, and ſet as many of thoſe parts on the ſhips ſide as conveniently you may, (which according to the ſhips length will be more or fewer.) Then when the ſhip runs one of thoſe parts in a *ſecond* of time, it is a mile an hour: when two, it is two miles an hour; when 5, it is 5 miles an hour. And in general, if you divide the number of parts run by the time of running accounted in *ſeconds*, the quotient ſhews what number of miles after that rate are run in an hour.

As if ſhe run 30 of thoſe parts in 5 *ſeconds*, it is 6 miles an hour; for dividing thirty by five, the quotient is ſix; ſo if ſhe runne 42 of thoſe parts in tenne *ſeconds*, dividing forty two

by 10. the quotient is $4\frac{2}{10}$, which ſheweth the ſhips way at that time to be after the rate of four miles and two tenths of a mile in an hour.

But for keeping this account of time it may be done either by a Sand-glaſſe for that purpoſe, or by pronouncing certain words or numbers: As the time wherein a man tells twice 60, pronouncing every number as faſt as he can conveniently and diſtinctly, is about a minute, ſo that the time wherein a man is numbring 60, is a half minute or 30 ſeconds, and whileſt a man is numbring two (as one and twenty, two and twenty) is a ſecond, and ſo whileſt a man is nombring from twenty to thirty, is five ſeconds, from twenty to forty ten ſeconds, &c. but in numbring from one to twenty you may obſerve the ſame times, as in numbring from one and twenty to forty, and this will not be hard to do; for whileſt a man pronounceth one and twenty, two and twenty, three and twenty, &c. there remains a certain impreſſion in the fantaſie, whereby a man is able in the ſame times to pronounce one, two, three, &c. And although this rule of numbring twice 60 for a minutes ſpace be not general unto all men, becauſe ſome are ſwifter or ſlower in their pronunciation then others; yet after this Example, a man making trial may frame a Rule to himſelf, whereby he may come ſomething neer the truth.

But leaving theſe, we come to the diviſion of the *Log-line*, according to the half minute-glaſſe, which is more uſual and certain. And conſidering that half a minute is of an hour the $\frac{1}{120}$ part, therefore the ſhips way running 51 feet in half a minute is a mile an hour, if ſhe run twice ſo much, that is, 102 feet in half a minute, it is two miles an hour; if thrice ſo much, it is three miles an hour. And in general, how many times 51 feet ſhe runnes in half a minute, ſo many miles is her way for an hour. Therefore leaving half a ſcore Fathom, or more from the *Log*, that ſo it may be out of the *Eddy* of the ſhips wake, before you begin to account or turn the glaſſe, if there you make a mark for the beginning, and ſo 51 feet from thence a mark of one knot, and 51 feet further a mark of two knots, and 51 feet further (that is, 153 feet from your firſt mark) another mark of three knots, and

and ſo proceeding: look how many knots are veered out in half a minute, ſo many miles is the ſhips way for an hour. Now for that which is veered out more above the juſt meaſure of a knot or knots, you may allow for every five feet the tenth part of a mile almoſt. As admit ſhe runne five knots, and 25 feet in half a minute, then is her way according to $5\frac{1}{10}$ or five miles and an half in an hour, if ſix knots and ten feet, it is $6\frac{2}{10}$ miles in an hour, &c.

But according to the common opinion of 5000 feet to a mile, and 60 ſuch miles to a Degree, there ſhould be ſomething leſſe then 7 fathom, namely, $41\frac{2}{3}$ feet to a knot.

And although he which veeres the *Log-line* be careful to over-hale it ſo ſlack, that it may not draw forwards the *Log*, yet (no doubt) it doth loſe ſome way, following the ſhip a little as it is drawn by the Line, and withall by the *Eddy* of the ſhips wake, and ſometimes alſo is caſt forwards by the winde and waves, when they come after the ſhip; ſo that for theſe cauſes it is like there may ſometimes be allowed three or four fathoms more then is veered out, but this, (as a thing mutable and uncertain) being ſometimes more, ſometimes leſſe, cannot be brought to anie certain Rule, but ſuch allowance may be made for it as a man in his experience and diſcretion finds fit.

If you would divide the *Log-line*, ſo as it might give the ſhips way in *Centeſmes*, or the hundreth part of a Degree, and fit it to an half Minute-glaſſe. Then ſeeing the hundreth part of a Degree is 36752 feet, and the $\frac{1}{100}$ part thereof is $50\frac{2}{3}$ feet; If you begin at the mark at which you mean to turn the glaſſe, & meaſure from thence 30 feet, and three fift parts of a foot, you may there place one knot: and thence again meaſuring 30 feet, and 3 fifth parts of a foot, there place two knots; and ſo proceeding at the end of every 30 feet and three fifths, adding a knot, the number of knots which runne out in half a minute, is the number of *centeſmes* which the ſhip runnes in an hour. As ſuppoſe there runne out tenne knots in half a minute, then the ſhips way is according to ten *Centeſmes* of a Degree in an houre, that is, the 10th part of a Degree, or ſix miles. And ſo every three foot abo[illegible] the

juſt.

juſt meaſure of knots, is neer the tenth part of a *Centeſme*, or the 100oth. part of a Degree. As if there run out of the *Log-line* 5 knots and 12 feet, then the ſhips way for an hour is 5 *Centeſmes*, and 4 tenth parts of a *Centeſme*: and the like is to be underſtood of others.

And after the form of theſe examples you may divide the *Log-line* for any other quantity of Time, more or leſſe then half a minute, or for any other parts of a Degree propoſed.

Thus have we handled the diviſion of the *Log-line*, according to the meaſure before found of 367200 *Engliſh-feet* in a Degree: But becauſe (as I have before-ſhewed) the ſhips way is commonly more then by the *Log-line* it appears to be: and every man deſires to have his reckoning ſomething before his ſhip, that he fall not with a place unexpected; For theſe and ſuch other cauſes, and for the rotundity of the number, if any man think it more ſafe and convenient in Sea-reckonings, he may abate 1 in 51, and ſo aſſign to a Degree onely 360000 feet, and conſequently to a mile 6000 *Engliſh-feet*.

And upon this ground, if in half a minute there run out 50 feet of the *Log-line*, it is a mile an hour; and ſo if 100 Feet run out in a minute.

For as 1 Minute is in proportion to 60 minutes:

So is 100 Feet, to 6000 Feet.

And ſo foraſmuch as twenty five Feet is $\frac{1}{240}$ part of a mile, and 15 *ſeconds* is alſo $\frac{1}{240}$ part of an hour: Therefore if there be two marks on the Ships ſide diſtant 25 feet, if the ſhip runne the diſtance of theſe two marks in 15 *ſeconds*, it is after the rate of a mile an hour; if in 5 *ſeconds*, it is three miles an hour, and ſo alwayes dividing 15 *ſeconds* by the number of *ſeconds* in which the ſhip runs that diſtance, the quotient ſhews the miles and parts of a mile runne in an hour. But if the Diſtance of theſe two marks be 50 foot, then if ſhe runne it in 30 *ſeconds*, or half a minute, it is a mile an hour; if in 10 ſeconds, three miles an hour; if in five *ſeconds* ſix miles an hour, (for 30 divided by 5, the quotient is 6.) And ſo alwayes dividing 30 *ſeconds* by the number of ſeconds, in which the ſhip runnes that Diſtance

ſtance; the quotient ſhews how many miles ſhe runs in an hour, &c.

Otherwiſe, if you make a mark on the ſhips ſide at every twenty Inches, then when the ſhip runs one of theſe parts in a ſecond of time, it is a mile an hour: when 5, it is 5 miles an hour; if ſhe run 18 of theſe parts in 3 ſeconds, it is 6 miles an hour: For dividing 18 by 3, the Quotient is 6. And in general, if you divide the number of the parts run by the number of *ſeconds* ſpent in running, the quotient ſhews the ſhips way in miles for an hour.

But for dividing the *Log-line* according to this ground of 6000 Feet in a Mile, if you intend to uſe it with a half Minute-glaſſe; then becauſe half a minute is $\frac{1}{120}$ part of an hour, and 50 Feet is alſo the $\frac{1}{120}$ part of a mile: Therefore when the ſhip runs 50 Feet in half a minute, her way is after the rate of a mile an hour; if 100 Feet in half a minute, it is two miles an hour, &c.

Therefore half a ſcore Fathomes or more from the *Log*, you may make a mark, and beginning from thence meaſure 50 Feet, and there make the firſt knot, and 50 Foot farther two knots, and 50 Foot farther three knots, and ſo proceeding: Look how many knots is run out in half a minute, ſo many miles is the ſhips way for an hour. And every five Feet more beſides the knots is a *tenth* part of a mile; As if there run out ſix knots and 40 Feet in half a minute, the ſhips way is after the rate of $6\frac{4}{10}$ miles in an hour, &c.

And ſo if the Glaſſe were for any other time more or leſſe then half a minute, you may make the diſtance of your knots proportional: As if it were for 20 *ſeconds*, then becauſe 20 *ſeconds* is of an hour the $\frac{1}{180}$ part, I divide a mile which is 6000 Feet by 180, and the quotient is $33\frac{1}{3}$; therefore there muſt be a knot at every 33 Feet and 4 inches.

If your Glaſſe be 36 *ſeconds* which is $\frac{1}{100}$ part of an hour, divide 6000 by 100, the quotient is 60, ſhewing that there muſt be 60 Feet to every knot, and then every ſix Foot over and above the knots is a *tenth* part of a mile more.

And

And ſo it is better that your Glaſſe be more then half a minute rather then leſſe, and the more the better, provided that there run out no more Line then you may hale in again, without danger of breaking.

Laſtly, if you would ſo divide the *Log-line*, that it might ſhew the ſhips way in *Centeſmes* of a Degree, and fit it to an half minute glaſſe: Then foraſmuch as the hundreth part of a Degree is 3600 feet, and the $\frac{1}{120}$ part thereof is 30 feet: therefore beginning at the mark whereat you intend to turn the Glaſſe, meaſure from thence 30 feet, and there make one knot, and at thirty feet further, two knots, &c. Then look how many knots run out in half a minute, ſo many *Centeſmes* of a Degree is the ſhips way for an hour. And ſo if the glaſſe be 36 *ſeconds*, then every knot muſt have 36 feet, &c.

Now if a man ſailing between any two Places, which lie neer Eaſt and Weſt one from another, have kept his reckoning by Courſe and Diſtance, uſing a *Log-line* ſo divided, that it have a knot at every 7 Fathomes (as many do) and would reduce the Diſtance of thoſe two places ſo found, to their Diſtance in ſuch miles, as theſe of ſixty to a Degree, each containing (as we have ſaid) 6000 Feet: The proportion in number of thoſe to theſe, is as 6 to 5: for 6 of them make 5 of theſe.

As admit a man in his dead Reckoning, uſing ſuch a *Log-line* as hath a knot at every 7 Fathomes, and for every knot running out in half a minute, he accounts the ſhips way to be ſo many miles an hour; and according to ſuch a reckoning ſuppoſe he finde the diſtance of two places to be 1224 Miles, or 408 leagues, and would know the Diſtance of the ſame places in miles of 6000 feet to a mile, which is according to a *Log-line* that hath a knot in every 50 foot.

Say then by the Rule of Proportion;

| | *Co. ar.* | |
|---|---|---|
| As the number 6 | | 9.22185 |
| Is in proportion to 5, | | 0.69897 |
| So is the number of miles given 1224 | | 3.08778 |
| To the number of miles required, 1020 | | 3.00860 |

Which

Which 1020 is the distance of those two Places, in such miles whereof 60 make a Degree; Or to finde the same in leagues, the proportion is; As 6 to 5; so is 408 leagues, to 340 leagues.

And thus may the Distances of places be found in such miles, whereof 60 make a Degree, especially if with the distance expressed in the *Plain Chart*, you compare the reckoning of some skilful Mariners that have sailed from the one to the other. But thus to endeavour a reformation of the *plain Chart* were a labour to little purpose; For there the correcting of the true situation of two places, in respect of one another, is oftentimes an occasion that the same places are the more falsly situate in respect of others. Like as if there were two places eight miles distant, and it were required to place a third three miles from either of them; Here if we set the third in the middle, it will be four miles distant from either: but if (attempting to mend that errour) we make the third to be 3 miles from the first, then will it be 5 Miles from the second: And thus unavoidably, the mending of the one is the marring of the other; because the thing proposed is not possible.

And such is the errour of the Plain or Common *Sea-Chart*, representing the Earth and Sea, not as a Spherical, but as a Plain Superficies; not as if the Meridians did concurre in the Poles, but as if they were alwayes parallel one to another. So that the graduation and projection being such, the Situations and Distances of places, cannot be generally and truly expressed therein.

But the graduation and projection of *Mercators Chart*, agreeing without sensible errour with the *Globe*, there may in that be described all or any parts of the World, according to their Longitudes, Latitudes, Courses, and Distances, as truly and far more conveniently for the *Mariners* use then upon the Globe it self; and upon such a *Chart*, so described, a reckoning may be truly kept, and any errour committed may easily be discerned and amended. VVhereas on the *plain Chart*, if a man find his reckoning to disagree, he is so far from knowing how to amend it, that he can seldome conjecture where the fault was.

The neglect and want of these *Charts* hath been and is a great

imperfection in *Navigation* and *Geography*. For howsoever there be some which do daily set forth for sale Maps of the World and of the parts thereof, according to this Projection: Yet to have them truly such, and fit for Navigation, requires in the Author or maker of them good knowledge, and some competent ability of his own, or aid from others, with a greater love to the Truth then to his own profit, which may induce him to bestow such industry, time, and expence, as I have formerly noted to be requisite in such a Work.

For the furtherance whereof, and of the Practice of Navigation in general; I shall indeavour in the two next Chapters to shew a methodical and orderly way of keeping a reckoning at Sea, more distinctly and exactly then hath been formerly used, and such as may aptly be set down in any Chart, and applied in the three principal kindes of Sailing; namely, according to the *Plain Chart*, or *Mercators*, or according to the Arch of a *Great Circle*. And by a few reckonings truly set down, according to this form, the Maps of the World and of the parts thereof might be much reformed.

## CHAP. VIII.

### *A formall and exact way of setting down and perfecting a Sea-reckoning.*

ALthough the Course and Distance cannot be soe truly and certainly known as the Latitude may be: yet we must indeavour in these also to come as neer the Truth as may be, the rather for that some reckonings must necessarily depend wholly upon them. And to that end, those which in their Voyages at Sea have occasion to runne farre upon any Course or Courses neer the Meridian, may do well to make trial of that which I have formerly set down, touching the quantity of a Degree on the Earth and Sea in our knowne Measure; and especially in *East-Indian* Voyages; sayling from the *Lizard* in

in the West part of *England* to *Cape de bonne Esperaunce* in *Africke*, they have opportunity of making an ample Experiment hereof.

But leaving this to the practice of the skilful and industrious *Sea-man*, we come now to shew an orderly and exact way of framing and keeping a reckoning at Sea: for which purpose I have made the *Table* following, which sheweth how much a ship is more Northerly or Southerly, and how much more Easterly or Westerly, by sailing upon any point or halfpoint of the *Compasse*, any number of miles proposed.

The like *Table* I made many years since, and taught the use of it in *Navigation*, whether it were then used by any other, I know not, I had it of no man; but this I speak, that if any man claim the first making and use of such an one, he may have it.

The ground of making this Table is the same with the former. *For as Radius is in proportion to the Distance run, So is the sine complement of the Rumb, to the distance of North or South, and so is the sine of the Rumb, to the distance of East or West.* Therefore here for ten miles upon any of the four points from the Meridian, we set in the second column the sine complement of that point (reduced into Degrees) and in the third the sine thereof. As the second Rumb or point from the Meridian, being 22 deg. 30 min. the sine complement thereof which is 9239 set in the second column against 10: and the sine thereof 3827, I set there in the third column; and having done thus, for ten miles in every column, the rest may be easily drawn from them.

As in the second column, for the first half point against 10 miles finding 9952, I set the half thereof; namely 4976 against 5 miles, and the tenth part thereof, namely 995 against 1 mile, which doubled or added to it self is 1990, to be set against two miles, whereto adding the same 995, the sum is 2985 for three miles, and so for the rest.

And thus for every point and half point from the Meridian, there are three columns: In the first whereof there is set down a number of miles runne upon that point or halfe point; the second sheweth how much the Latitude is altered; that

is how much you are more Southerly or Northerly, by running ſo farre upon that point or half point; The third, how much you are more Eaſterly or VVeſterly, by running that courſe and diſtance.

The Numbers ſet in every firſt column from 1 to 10, are alſo to be underſtood from 10 to 100, or from 100 to 1000; and the Figure in the fourth place of the ſecond and third columns, anſwer to the figure in the firſt. As admit a Ship run South and by VVeſt (that is (South 1 point VVeſterly) 165 miles) I ſet down this number thus; and looking in the Columns of the firſt *Rumb* againſt 10, (which may be underſtood to be 100) I find againſt it in the ſecond column 981 almoſt, and in the third 195. alſo againſt 60, (that is 6) in the firſt column, there is 588 in the ſecond, and 117 in the third: alſo againſt 5 in the firſt column, there is 49 in the ſecond, and almoſt 10 in the third.

| | | | |
|---|---|---|---|
| | 100 | 981 | 195 |
| *SW.* 1. | 60 | 588 | 117 |
| *point.* | 5 | 49 | 10 |
| | 165 | 161.8 | 32.2 |

Theſe ſet down, and ſumm'd up, as here appeareth, ſhew that a Ship running *S* by *W* 165 miles, is to the Southwards of the place from whence ſhe departed 161 miles and 8 *tenth* parts of a mile, and to the VVeſtwards 32 miles, and 2 *tenth* parts of a mile. If you deſire more exactneſſe you may uſe all the places, for the firſt or greateſt number, which is here 100.

| | | | |
|---|---|---|---|
| | 100 | 9808 | 1959 |
| *SW.* 1. | 60 | 5885 | 1170 |
| *point* | 5 | 490 | 97 |
| | 165. | 161.83 | 32.17 |

As in the ſecond Example, where the Southerly diſtance is 161 $\frac{83}{100}$ miles, & the Weſterly 32 $\frac{17}{100}$ miles.

A Table

*A Table of the Northing or Southing, Easting or Westing of every Rumb and half Rumb from the Meridian; according to the number of Miles run upon that Rumb.*

| M. | ½ poin. 5.37½ | 7½ poin. 84.22½ | 1 poin. 11.15 | 7 poin. 78.45 | 1½ poin 16.52 | 6½ poi. 73.7½ | 2 poin. 21.30 | 6 poin. 67.30 |
|---|---|---|---|---|---|---|---|---|
| 1 | 995 | 98 | 981 | 195 | 957 | 290 | 924 | 383 |
| 2 | 1990 | 196 | 1962 | 390 | 1914 | 580 | 1848 | 766 |
| 3 | 2986 | 294 | 2943 | 585 | 2871 | 870 | 2772 | 1148 |
| 4 | 3981 | 392 | 3923 | 780 | 3827 | 1161 | 3696 | 1531 |
| 5 | 4976 | 490 | 4904 | 975 | 4784 | 1451 | 4620 | 1914 |
| 6 | 5971 | 588 | 5885 | 1170 | 5741 | 1741 | 5544 | 2297 |
| 7 | 6966 | 686 | 6866 | 1365 | 6698 | 2031 | 6468 | 2680 |
| 8 | 7961 | 784 | 7846 | 1560 | 7655 | 2321 | 7392 | 3062 |
| 9 | 8957 | 882 | 8827 | 1755 | 8512 | 2612 | 8315 | 3445 |
| 10 | 9952 | 980 | 9808 | 1950 | 9569 | 2902 | 9239 | 3827 |

| M | 2½ poi. 82.7½ | 5½ poin 61.52½ | 3 poin 33.45 | 5 poin. 56.15 | 3½ poin 39.22½ | 4½ poi. 50.37½ | 4 poin. 45.00 | 4 poin. 45.00 |
|---|---|---|---|---|---|---|---|---|
| 1 | 882 | 471 | 831 | 556 | 773 | 634 | 707 | 707 |
| 2 | 1764 | 942 | 1663 | 1111 | 1546 | 1269 | 1414 | 1414 |
| 3 | 2646 | 1414 | 2494 | 1667 | 2319 | 1903 | 2121 | 2121 |
| 4 | 3528 | 1885 | 3326 | 2222 | 3092 | 2538 | 2828 | 2828 |
| 5 | 4410 | 2357 | 4158 | 2778 | 3865 | 3172 | 3535 | 3535 |
| 6 | 5292 | 2828 | 4989 | 3334 | 4638 | 3806 | 4242 | 4242 |
| 7 | 6174 | 3300 | 5820 | 3890 | 5411 | 4440 | 4949 | 4949 |
| 8 | 7056 | 3771 | 6652 | 4445 | 6184 | 5075 | 5656 | 5656 |
| 9 | 7937 | 4243 | 7483 | 5000 | 6957 | 5710 | 6364 | 6364 |
| 10 | 8819 | 4714 | 8315 | 5556 | 7730 | 6344 | 7071 | 7071 |

A larger Example may be that before set down in the last *Probleme* of Sailing by a *Great Circle* from *Summer-Islands* to the *Lizard*, pag. 127.

As admit I sail from thence: first, *N E* ½ point Easterly 600 miles, then *N E by E* 300 miles; East North-east half a point Northerly 495 miles; East N E 390 miles; E N E, ½ point Easterly 264 miles; E by N 210 miles; East 951 miles: These Courses and Distances I set down in such form as here appeareth, where in the first column there is expressed the Course or point of the Compasse upon which a man sails: In the second column, the Distance of that *Rumb* from the *Meridian*: In the third column, the Distance run upon that *Point*; In the rest, the difference of *Latitude*, and departure from the *Meridian* in miles and *tenth* parts of a mile.

| *Course* | *Rumb frõme.* | *Dist. miles.* | *North.* | *South* | *East* | *West* |
|---|---|---|---|---|---|---|
| *N E* ½ *Po. E.* | *North Easterly* 4½ *P* | 600 | 380.6 | | 463.8 | |
| *NE by E.* | *NEast* 5 *Point* | 300 | 166.7 | | 2494 | |
| *ENE* ½ *Po. N.* | *NEast* 5 ½ *Po.* | 400 | 1885 | | 3528 | |
| | | 90 | 424 | | 794 | |
| | | 5 | 24 | | 44 | |
| *ENE* | *NEast* 6 *Po.* | 300 | 1148 | | 277.2 | |
| | | 90 | 344 | | 831 | |
| *ENE* ½ *Po. E.* | *NEast* 6 ½ *Po.* | 200 | 580 | | 1914 | |
| | | 60 | 174 | | 574 | |
| | | 4 | 12 | | 38 | |
| *E by N* | *NEast* 7 *Po.* | 200 | 390 | | 1962 | |
| | | 10 | 20 | | 98 | |
| | | 900 | | | 9510 | |
| *East* | *East* | 50 | | | | |
| | | 1 | | | | |
| | | 3210 | 1047.4 | | 29197 | |

(In

(In all which is to be conceived, that the *Variations* are allowed) ſo that at the Foot of this reckoning, I finde the ſumme of the North-column to be 1047$\frac{4}{5}$ miles, and the ſumme of the Eaſt column 2920 miles almoſt; the firſt, namely 1047 miles converted into degrees, is 17 degrees, 27 min. the difference of Latitude, which added to the Latitude of *Summer-Iſlands* 32 deg. 25 min. (where this reckoning began) the ſumme is 49 deg. 52 min. which is the Latitude of this laſt place where this reckoning endeth. So that according to this account, the Ship is run into the Latitude of 49 deg. 52 min. and hath altered her Longitude to the Eaſtwards 2920 miles, of ſuch miles, whereof 60 make a degree of a great Circle.

Therefore, if you ſet down this reckoning on the *Plain Chart*, you muſt make a point in the *Chart* that may be in the Latitude of 49 deg. 52 min. and to the Eaſtwards of *Summer-Iſlands*, (where this reckoning began) 2920 miles, that is, you muſt run a parallel (with your Compaſſes or otherwiſe) on your *Chart* in the Latitude of 49 degrees 52 minutes, and croſſe the ſame by a Meridian, which may be to the Eaſtwards of the Meridian of *Summer-Iſlands* 2920 miles, and ſo the point of the interſection of this parallel and Meridian, is the Traverſe-point or point in the *Chart*, repreſenting the place where the Ship is in the end of this Reckoning.

But if you ſet down this reckoning on *Mercators Chart*, you muſt alſo finde a point that may be in the Latitude of 49 deg. 52 min. and may likewiſe be to the Eaſtwards of *Summer-Iſlands* 2920 miles, which is done by running with your compaſſes a parallel in the Latitude of 49 deg. 52 min. and croſſing the ſame by a Meridian, which may be to the Eaſtwards of the Meridian of *Summer-Iſlands* 2920 miles, the point of the interſection of this parallel with that Meridian is the traverſe point, repreſenting in the *Chart* the place where the ſhip then is.

For it is to be conceived in this *Chart*, that the degrees of the Meridian intercepted between the Latitudes of two places are as a ſcale for thoſe two places, to meaſure not onely their difference of *Latitude*, but likewiſe their diſtance in their *Rumb*, as alſo the diſtance of their *Meridians*.

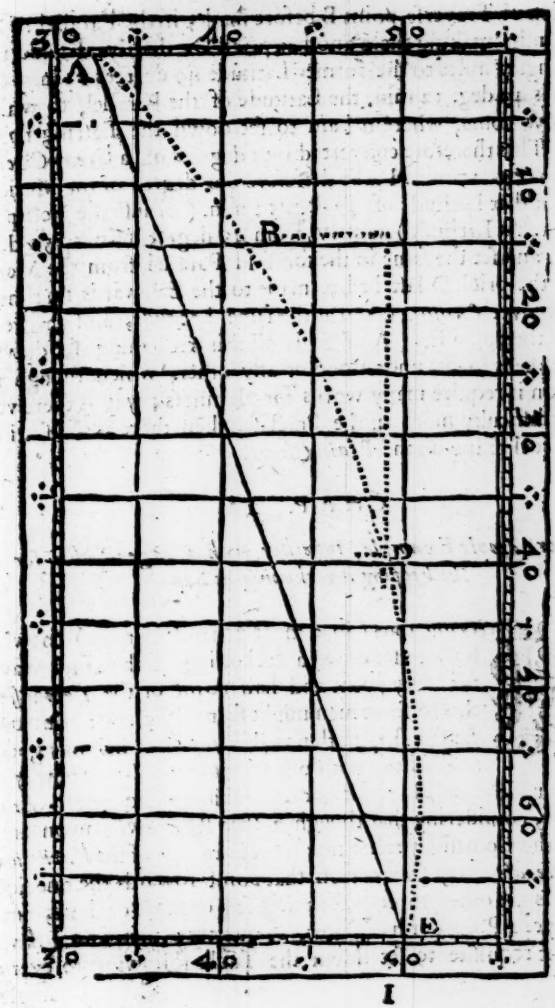
But

But becauſe it often falls out, that in ſailing from place to place, a ſhip runnes not neer the Rumb of the two places by many hundred Miles, eſpecially in ſailing by the Arch of a *Great Circle*, which is the moſt exquiſite manner of ſailing, and wherein a man ſhifts his Courſe often, and runnes much farther in one Latitude then in another, as by the former example may appear. Therefore once in three or four dayes, or ſo often as you alter your Courſe much, you may transfer or ſet down your Reckoning out of your Book into your *Chart*. As in transferring the former example, you may ſet down the Northing and Eaſting of every of the Courſes ſeverally; but for brevities ſake will bring them into three parts (and ſo alſo we ſhall not much erre.)

And thus for the two firſt Courſes, namely *NE* ⅓ point Eaſterly 600 miles, and *NE by E* 300 miles, I find in the North column 547 miles; and in the Eaſt column 713 miles: alſo for the three next Courſes ſumming up the North and Eaſt columns, I finde the Northing to be 459 miles, and the Eaſting 1050 miles. Alſo for the two laſt Courſes, I find the Northing to be 41 miles, and the Eaſting 1157 miles.

| *North* | *Eaſt.* |
|---|---|
| 547 | 713 |
| 459 | 1050 |
| 41 | 1157 |
| 1047 | 2920 |

Now to transfer theſe into the *Chart*, I conſider that 547 miles is 9 degrees 7 minutes, which added to the former Latitude 32 deg. 25 min. makes Latitude 41 deg. 32 min. In which Latitude I run a parallel, then conſidering that 713 miles is 11 deg. 53 min. I take this 11 deg. 53 min. in the Meridian, aſmuch above the one Latitude, as beneath the other, namely, from 31 deg. 0 min. to 42 degrees 53 minutes, and this I ſet in the foreſaid parallel from the Meridian of *Summer-Iſlands* to the Eaſtwards, and there make the point B, then reducing 459 miles into degr. it makes 7 degr. 39 min. which added to 41 degr. 32 min. makes Latitude 49 degr. 11 min. Alſo the Eaſting 1050 miles are 17 deg. 30 min. the half whereof 8 deg. 45 min. I take in the Meridian from above 41 deg. 32 min. beneath 49 degr. 11 minutes, namely, from 41 deg. 20 min. to 50 deg. 5 min. And this being doubled (becauſe it is but the half) I ſet from the Meridian of the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50
I

the prick or Traverſe-point B before made, in the Parallel of 49 deg. 11 min. making there another prick D. Laſtly, I adde the Northing 41 miles to the former Latitude 49 degrees 11 min. the ſumme is 49 deg. 52 min. the Latitude of the Parallel, to which I am now come, wherein I am to ſet down the Eaſting 1157 miles: This therefore converted into degrees of a *Great Circle*, make 19 deg. 17 min. I take therefore one degree of the Meridian, about that Latitude of 49 deg. 52 min. (becauſe the moſt part is run in that Latitude) namely, from 49 deg. 30 min. to 50 deg. 30 min. and ſet the ſame in the foreſaid Parallel from the Meridian of the prick D laſt before made to the Eaſtwards 19 times, and moreover 17 min. taken at the ſame Latitude, and this reacheth to the point E. And ſo is all this reckoning ſet down, and the like is to be underſtood of any other, which though in expreſſion it require many words for plainneſs; yet is there very little difficulty more in the Practiſe, then there is in ſetting down a reckoning on the *Plain Chart*.

## CHAP. IX.

### *A more ample Example, together with a larger Table for the keeping a reckoning at Sea.*

HAving thus (in a more general manner) ſhewed how to ſet down a reckoning of the ſhips way, for every point and half point of the *Compaſſe*, this to ſome men might ſeem ſufficient: But becauſe a ſhip doth not alwayes make her way good as ſhe lies, nor doth her *Leeward*-way alwayes fall juſtly upon a whole point, or half point, or quarter; And moreover, conſidering that though a ſhip ſteer away upon any point of the Comaſſe, yet her true way, by reaſon of the *Variation of the Needle*, may ſwerve from that point towards the one ſide or towards the other, three or four degrees, or more or leſſe, and not alwayes a Point, or half Point, or quarter: therefore I have thought it requiſite to ſet down the Table following to every ſingle

ſingle Degree: and that a man might the more readily with one or two Entrances have his deſire, I have alſo enlarged the number of miles unto 100. The ground and way of making this Table differs not from the former, and it is to be uſed almoſt in the ſelf-ſame manner: wherefore we ſhall uſe the more brevity handling of it.

*Here followeth a* Table *of the Northing or Southing, Eaſting or Weſting of every Degree from the Meridian, according to the number of Miles run upon that Degree,* which for brevity ſake we will call——

# A TABLE For the DIFFERENCE OF LATITVDE, AND Departure from the *Meridian.*

| M. | l. d. | 89 d. | M. | l. d. | 89 d. | Min. | l. d. | 89 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 0 | 35 | 350 | 6 | 69 | 690 | 12 |
| 2 | 20 | 0 | 36 | 360 | 7 | 70 | 700 | 12 |
| 3 | 30 | 0 | 37 | 370 | 7 | 71 | 710 | 13 |
| 4 | 40 | 1 | 38 | 380 | 7 | 72 | 720 | 13 |
| 5 | 50 | 1 | 39 | 390 | 7 | 73 | 730 | 13 |
| 6 | 60 | 1 | 40 | 400 | 7 | 74 | 740 | 13 |
| 7 | 70 | 1 | 41 | 410 | 7 | 75 | 750 | 13 |
| 8 | 80 | 1 | 42 | 420 | 7 | 76 | 760 | 13 |
| 9 | 90 | 2 | 43 | 430 | 8 | 77 | 770 | 14 |
| 10 | 100 | 2 | 44 | 440 | 8 | 78 | 780 | 14 |
| 11 | 110 | 2 | 45 | 450 | 8 | 79 | 790 | 14 |
| 12 | 120 | 2 | 46 | 460 | 8 | 80 | 800 | 14 |
| 13 | 130 | 2 | 47 | 470 | 8 | 81 | 810 | 14 |
| 14 | 140 | 2 | 48 | 480 | 8 | 82 | 820 | 14 |
| 15 | 150 | 3 | 49 | 490 | 9 | 83 | 830 | 15 |
| 16 | 160 | 3 | 50 | 500 | 9 | 84 | 840 | 15 |
| 17 | 170 | 3 | 51 | 510 | 9 | 85 | 850 | 15 |
| 18 | 180 | 3 | 52 | 520 | 9 | 86 | 860 | 15 |
| 19 | 190 | 3 | 53 | 530 | 9 | 87 | 870 | 15 |
| 20 | 200 | 4 | 54 | 540 | 10 | 88 | 880 | 15 |
| 21 | 210 | 4 | 55 | 550 | 10 | 89 | 890 | 16 |
| 22 | 220 | 4 | 56 | 560 | 10 | 90 | 900 | 16 |
| 23 | 230 | 4 | 57 | 570 | 10 | 91 | 910 | 16 |
| 24 | 240 | 4 | 58 | 580 | 10 | 92 | 920 | 16 |
| 25 | 250 | 4 | 59 | 590 | 10 | 93 | 930 | 16 |
| 26 | 260 | 5 | 60 | 600 | 11 | 94 | 940 | 17 |
| 27 | 270 | 5 | 61 | 610 | 11 | 95 | 950 | 17 |
| 28 | 280 | 5 | 62 | 620 | 11 | 96 | 960 | 17 |
| 29 | 290 | 5 | 63 | 630 | 11 | 97 | 970 | 17 |
| 30 | 300 | 5 | 64 | 640 | 11 | 98 | 980 | 17 |
| 31 | 310 | 5 | 65 | 650 | 12 | 99 | 990 | 17 |
| 32 | 320 | 6 | 66 | 660 | 12 | 100 | 1000 | 18 |
| 33 | 330 | 6 | 67 | 670 | 12 | 200 | 2000 | 35 |
| 34 | 340 | 6 | 68 | 680 | 12 | 300 | 3000 | 53 |

| M | 2 d. | 88 d. | M | 2 d. | 88 d. | Min. | 2 d. | 88 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 0 | 35 | 350 | 12 | 69 | 690 | 24 |
| 2 | 20 | 1 | 36 | 360 | 13 | 70 | 700 | 24 |
| 3 | 30 | 1 | 37 | 370 | 13 | 71 | 710 | 25 |
| 4 | 40 | 1 | 38 | 380 | 13 | 72 | 720 | 25 |
| 5 | 50 | 2 | 39 | 390 | 14 | 73 | 730 | 25 |
| 6 | 60 | 2 | 40 | 400 | 14 | 74 | 740 | 26 |
| 7 | 70 | 2 | 41 | 410 | 14 | 75 | 750 | 26 |
| 8 | 80 | 3 | 42 | 420 | 15 | 76 | 760 | 26 |
| 9 | 90 | 3 | 43 | 430 | 15 | 77 | 770 | 27 |
| 10 | 100 | 3 | 44 | 440 | 15 | 78 | 780 | 27 |
| 11 | 110 | 4 | 45 | 450 | 16 | 79 | 790 | 28 |
| 12 | 120 | 4 | 46 | 460 | 16 | 80 | 800 | 28 |
| 13 | 130 | 4 | 47 | 470 | 16 | 81 | 809 | 28 |
| 14 | 140 | 5 | 48 | 480 | 17 | 82 | 819 | 29 |
| 15 | 150 | 5 | 49 | 490 | 17 | 83 | 829 | 29 |
| 16 | 160 | 6 | 50 | 500 | 17 | 84 | 839 | 29 |
| 17 | 170 | 6 | 51 | 510 | 18 | 85 | 849 | 30 |
| 18 | 180 | 6 | 52 | 520 | 18 | 86 | 859 | 30 |
| 19 | 190 | 7 | 53 | 530 | 18 | 87 | 869 | 30 |
| 20 | 200 | 7 | 54 | 540 | 19 | 88 | 879 | 31 |
| 21 | 210 | 7 | 55 | 550 | 19 | 89 | 889 | 31 |
| 22 | 220 | 8 | 56 | 560 | 19 | 90 | 899 | 31 |
| 23 | 230 | 8 | 57 | 570 | 20 | 91 | 909 | 32 |
| 24 | 240 | 8 | 58 | 580 | 20 | 92 | 919 | 32 |
| 25 | 250 | 9 | 59 | 590 | 20 | 93 | 929 | 32 |
| 26 | 260 | 9 | 60 | 600 | 21 | 94 | 939 | 33 |
| 27 | 270 | 9 | 61 | 610 | 21 | 95 | 949 | 33 |
| 28 | 280 | 10 | 62 | 620 | 22 | 96 | 959 | 34 |
| 29 | 290 | 10 | 63 | 630 | 22 | 97 | 969 | 34 |
| 30 | 300 | 10 | 64 | 640 | 22 | 98 | 979 | 34 |
| 31 | 310 | 11 | 65 | 650 | 23 | 99 | 989 | 35 |
| 32 | 320 | 11 | 66 | 660 | 23 | 100 | 999 | 35 |
| 33 | 330 | 11 | 67 | 670 | 23 | 200 | 1999 | 70 |
| 34 | 340 | 12 | 68 | 680 | 24 | 300 | 2998 | 105 |

| M | 3 d | 87 d. |
|---|---|---|
| 1 | 10 | 1 |
| 2 | 20 | 1 |
| 3 | 30 | 1 |
| 4 | 40 | 2 |
| 5 | 50 | 2 |
| 6 | 60 | 3 |
| 7 | 70 | 4 |
| 8 | 80 | 4 |
| 9 | 90 | 5 |
| 10 | 100 | 5 |
| 11 | 110 | 6 |
| 12 | 120 | 6 |
| 13 | 130 | 7 |
| 14 | 140 | 7 |
| 15 | 150 | 8 |
| 16 | 160 | 8 |
| 17 | 170 | 9 |
| 18 | 180 | 9 |
| 19 | 190 | 10 |
| 20 | 200 | 10 |
| 21 | 210 | 11 |
| 22 | 220 | 11 |
| 23 | 230 | 12 |
| 24 | 240 | 12 |
| 25 | 250 | 13 |
| 26 | 260 | 13 |
| 27 | 270 | 14 |
| 28 | 280 | 15 |
| 29 | 290 | 15 |
| 30 | 300 | 16 |
| 31 | 310 | 16 |
| 32 | 320 | 17 |
| 33 | 330 | 17 |
| 34 | 340 | 18 |
| 35 | 350 | 18 |
| 36 | 360 | 19 |
| 37 | 370 | 19 |
| 38 | 380 | 20 |
| 39 | 390 | 20 |
| 40 | 400 | 21 |
| 41 | 410 | 21 |
| 42 | 420 | 22 |
| 43 | 430 | 22 |
| 44 | 440 | 23 |
| 45 | 450 | 23 |
| 46 | 460 | 24 |
| 47 | 470 | 24 |
| 48 | 480 | 25 |
| 49 | 490 | 26 |
| 50 | 500 | 26 |
| 51 | 509 | 27 |
| 52 | 519 | 27 |
| 53 | 529 | 28 |
| 54 | 539 | 28 |
| 55 | 549 | 29 |
| 56 | 559 | 29 |
| 57 | 569 | 30 |
| 58 | 579 | 30 |
| 59 | 589 | 31 |
| 60 | 599 | 31 |
| 61 | 609 | 32 |
| 62 | 619 | 32 |
| 63 | 629 | 33 |
| 64 | 639 | 33 |
| 65 | 649 | 34 |
| 66 | 659 | 35 |
| 67 | 669 | 35 |
| 68 | 679 | 36 |

| Min. | 3 d. | 87 d. |
|---|---|---|
| 69 | 689 | 36 |
| 70 | 699 | 37 |
| 71 | 709 | 37 |
| 72 | 719 | 38 |
| 73 | 729 | 38 |
| 74 | 739 | 39 |
| 75 | 749 | 39 |
| 76 | 759 | 40 |
| 77 | 769 | 40 |
| 78 | 779 | 41 |
| 79 | 789 | 41 |
| 80 | 799 | 42 |
| 81 | 809 | 42 |
| 82 | 819 | 43 |
| 83 | 829 | 43 |
| 84 | 839 | 44 |
| 85 | 849 | 44 |
| 86 | 859 | 45 |
| 87 | 869 | 45 |
| 88 | 879 | 46 |
| 89 | 889 | 46 |
| 90 | 899 | 47 |
| 91 | 909 | 48 |
| 92 | 919 | 48 |
| 93 | 929 | 49 |
| 94 | 939 | 49 |
| 95 | 949 | 50 |
| 96 | 959 | 50 |
| 97 | 969 | 51 |
| 98 | 979 | 51 |
| 99 | 989 | 52 |
| 100 | 999 | 52 |
| 200 | 1997 | 105 |
| 300 | 2996 | 157 |

| M | 4d. | 86d. |
|---|---|---|
| 1 | 10 | 1 |
| 2 | 20 | 1 |
| 3 | 30 | 2 |
| 4 | 40 | 3 |
| 5 | 50 | 3 |
| 6 | 60 | 4 |
| 7 | 70 | 5 |
| 8 | 80 | 6 |
| 9 | 90 | 6 |
| 10 | 100 | 7 |
| 11 | 110 | 8 |
| 12 | 120 | 8 |
| 13 | 130 | 9 |
| 14 | 140 | 10 |
| 15 | 150 | 10 |
| 16 | 159 | 11 |
| 17 | 169 | 12 |
| 18 | 179 | 13 |
| 19 | 189 | 13 |
| 20 | 199 | 14 |
| 21 | 209 | 15 |
| 22 | 219 | 15 |
| 23 | 229 | 16 |
| 24 | 239 | 17 |
| 25 | 249 | 17 |
| 26 | 259 | 18 |
| 27 | 269 | 19 |
| 28 | 279 | 20 |
| 29 | 289 | 20 |
| 30 | 299 | 21 |
| 31 | 309 | 22 |
| 32 | 319 | 22 |
| 33 | 329 | 23 |
| 34 | 339 | 24 |
| 35 | 349 | 25 |
| 36 | 359 | 25 |
| 37 | 369 | 26 |
| 38 | 379 | 27 |
| 39 | 389 | 27 |
| 40 | 399 | 28 |
| 41 | 409 | 29 |
| 42 | 419 | 29 |
| 43 | 429 | 30 |
| 44 | 439 | 31 |
| 45 | 449 | 31 |
| 46 | 459 | 32 |
| 47 | 469 | 33 |
| 48 | 479 | 34 |
| 49 | 489 | 34 |
| 50 | 499 | 35 |
| 51 | 509 | 36 |
| 52 | 519 | 36 |
| 53 | 529 | 37 |
| 54 | 539 | 38 |
| 55 | 549 | 38 |
| 56 | 559 | 39 |
| 57 | 569 | 40 |
| 58 | 579 | 40 |
| 59 | 589 | 41 |
| 60 | 599 | 42 |
| 61 | 609 | 43 |
| 62 | 619 | 43 |
| 63 | 629 | 44 |
| 64 | 639 | 45 |
| 65 | 648 | 45 |
| 66 | 658 | 46 |
| 67 | 668 | 47 |
| 68 | 678 | 48 |

| Min. | 4 d. | 86 d. |
|---|---|---|
| 69 | 688 | 48 |
| 70 | 698 | 49 |
| 71 | 708 | 50 |
| 72 | 718 | 50 |
| 73 | 728 | 51 |
| 74 | 738 | 52 |
| 75 | 748 | 52 |
| 76 | 758 | 53 |
| 77 | 768 | 54 |
| 78 | 778 | 55 |
| 79 | 788 | 55 |
| 80 | 798 | 56 |
| 81 | 808 | 57 |
| 82 | 818 | 57 |
| 83 | 828 | 58 |
| 84 | 838 | 59 |
| 85 | 848 | 59 |
| 86 | 858 | 60 |
| 87 | 868 | 61 |
| 88 | 878 | 61 |
| 89 | 888 | 62 |
| 90 | 898 | 63 |
| 91 | 908 | 63 |
| 92 | 918 | 64 |
| 93 | 928 | 65 |
| 94 | 938 | 66 |
| 95 | 948 | 66 |
| 96 | 958 | 67 |
| 97 | 968 | 68 |
| 98 | 978 | 68 |
| 99 | 988 | 69 |
| 100 | 998 | 70 |
| 200 | 1995 | 140 |
| 300 | 2983 | 209 |

| M. | 5 d. | 85 d. | M. | 5 d. | 85 d. | Min. | 5 d. | 85 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 1 | 35 | 349 | 30 | 69 | 687 | 60 |
| 2 | 20 | 2 | 36 | 359 | 31 | 70 | 697 | 61 |
| 3 | 30 | 3 | 37 | 369 | 32 | 71 | 707 | 62 |
| 4 | 40 | 3 | 38 | 379 | 33 | 72 | 717 | 63 |
| 5 | 50 | 4 | 39 | 388 | 34 | 73 | 727 | 64 |
| 6 | 60 | 5 | 40 | 398 | 35 | 74 | 737 | 65 |
| 7 | 70 | 6 | 41 | 408 | 36 | 75 | 747 | 65 |
| 8 | 80 | 7 | 42 | 418 | 37 | 76 | 757 | 66 |
| 9 | 90 | 8 | 43 | 428 | 37 | 77 | 767 | 67 |
| 10 | 100 | 9 | 44 | 438 | 38 | 78 | 777 | 68 |
| 11 | 110 | 10 | 45 | 448 | 39 | 79 | 787 | 69 |
| 12 | 120 | 10 | 46 | 458 | 40 | 80 | 797 | 70 |
| 13 | 130 | 11 | 47 | 468 | 41 | 81 | 807 | 71 |
| 14 | 140 | 12 | 48 | 478 | 42 | 82 | 817 | 71 |
| 15 | 150 | 13 | 49 | 488 | 43 | 83 | 827 | 72 |
| 16 | 159 | 14 | 50 | 498 | 44 | 84 | 837 | 73 |
| 17 | 169 | 15 | 51 | 508 | 45 | 85 | 847 | 74 |
| 18 | 179 | 16 | 52 | 518 | 45 | 86 | 857 | 75 |
| 19 | 189 | 17 | 53 | 528 | 46 | 87 | 867 | 76 |
| 20 | 199 | 17 | 54 | 538 | 47 | 88 | 877 | 77 |
| 21 | 209 | 18 | 55 | 548 | 48 | 89 | 887 | 78 |
| 22 | 219 | 19 | 56 | 558 | 49 | 90 | 897 | 78 |
| 23 | 229 | 20 | 57 | 568 | 50 | 91 | 907 | 79 |
| 24 | 239 | 21 | 58 | 578 | 51 | 92 | 916 | 80 |
| 25 | 249 | 22 | 59 | 588 | 52 | 93 | 926 | 81 |
| 26 | 259 | 23 | 60 | 598 | 52 | 94 | 936 | 82 |
| 27 | 269 | 24 | 61 | 608 | 53 | 95 | 946 | 83 |
| 28 | 279 | 24 | 62 | 618 | 54 | 96 | 956 | 84 |
| 29 | 289 | 25 | 63 | 628 | 55 | 97 | 966 | 84 |
| 30 | 299 | 26 | 64 | 638 | 56 | 98 | 976 | 85 |
| 31 | 309 | 27 | 65 | 648 | 57 | 99 | 986 | 86 |
| 32 | 319 | 28 | 66 | 658 | 58 | 100 | 996 | 87 |
| 33 | 329 | 129 | 67 | 668 | 58 | 200 | 1992 | 174 |
| 34 | 339 | 30 | 68 | 677 | 59 | 300 | 2989 | 262 |

| M | 6 d. | 84d | M | 6 d. | 84d | Min. | 6 d. | 84 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 1 | 35 | 348 | 39 | 69 | 686 | 72 |
| 2 | 20 | 2 | 36 | 358 | 38 | 70 | 696 | 73 |
| 3 | 30 | 3 | 37 | 368 | 39 | 71 | 706 | 74 |
| 4 | 40 | 4 | 38 | 378 | 40 | 72 | 716 | 75 |
| 5 | 50 | 5 | 39 | 388 | 41 | 73 | 726 | 76 |
| 6 | 60 | 6 | 40 | 398 | 42 | 74 | 736 | 77 |
| 7 | 70 | 7 | 41 | 408 | 43 | 75 | 746 | 78 |
| 8 | 80 | 8 | 42 | 418 | 44 | 76 | 756 | 79 |
| 9 | 89 | 9 | 43 | 428 | 45 | 77 | 766 | 80 |
| 10 | 99 | 10 | 44 | 438 | 46 | 78 | 776 | 81 |
| 11 | 109 | 11 | 45 | 447 | 47 | 79 | 786 | 82 |
| 12 | 119 | 12 | 46 | 457 | 48 | 80 | 796 | 83 |
| 13 | 129 | 14 | 47 | 467 | 49 | 81 | 806 | 85 |
| 14 | 139 | 15 | 48 | 477 | 50 | 82 | 815 | 86 |
| 15 | 149 | 16 | 49 | 487 | 51 | 83 | 825 | 87 |
| 16 | 159 | 17 | 50 | 497 | 52 | 84 | 835 | 88 |
| 17 | 169 | 18 | 51 | 507 | 53 | 85 | 845 | 89 |
| 18 | 179 | 19 | 52 | 517 | 54 | 86 | 855 | 90 |
| 19 | 189 | 20 | 53 | 527 | 55 | 87 | 865 | 91 |
| 20 | 199 | 21 | 54 | 537 | 56 | 88 | 875 | 92 |
| 21 | 209 | 22 | 55 | 547 | 57 | 89 | 885 | 93 |
| 22 | 219 | 23 | 56 | 557 | 58 | 90 | 895 | 94 |
| 23 | 229 | 24 | 57 | 567 | 59 | 91 | 905 | 95 |
| 24 | 239 | 25 | 58 | 577 | 61 | 92 | 915 | 96 |
| 25 | 249 | 26 | 59 | 587 | 62 | 93 | 925 | 97 |
| 26 | 259 | 27 | 60 | 597 | 63 | 94 | 935 | 98 |
| 27 | 268 | 28 | 61 | 607 | 64 | 95 | 945 | 99 |
| 28 | 278 | 29 | 62 | 617 | 65 | 96 | 955 | 100 |
| 29 | 288 | 30 | 63 | 627 | 66 | 97 | 965 | 101 |
| 30 | 298 | 31 | 64 | 637 | 67 | 98 | 975 | 102 |
| 31 | 308 | 32 | 65 | 646 | 68 | 99 | 985 | 103 |
| 32 | 318 | 33 | 66 | 656 | 69 | 100 | 995 | 104 |
| 33 | 328 | 34 | 67 | 666 | 70 | 200 | 1989 | 209 |
| 34 | 338 | 35 | 68 | 676 | 71 | 300 | 2983 | 313 |

| M | 7 d. | 83 d. | M | 7 d. | 83 d. | Min. | 7 d. | 83 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 1 | 35 | 347 | 43 | 69 | 685 | 84 |
| 2 | 20 | 2 | 36 | 357 | 44 | 70 | 695 | 85 |
| 3 | 30 | 4 | 37 | 367 | 45 | 71 | 705 | 87 |
| 4 | 40 | 5 | 38 | 377 | 46 | 72 | 715 | 88 |
| 5 | 50 | 6 | 39 | 387 | 48 | 73 | 725 | 89 |
| 6 | 60 | 7 | 40 | 397 | 49 | 74 | 734 | 90 |
| 7 | 69 | 8 | 41 | 407 | 50 | 75 | 744 | 92 |
| 8 | 79 | 10 | 42 | 417 | 51 | 76 | 754 | 93 |
| 9 | 89 | 11 | 43 | 427 | 52 | 77 | 764 | 94 |
| 10 | 99 | 12 | 44 | 437 | 54 | 78 | 774 | 95 |
| 11 | 109 | 13 | 45 | 447 | 55 | 79 | 784 | 96 |
| 12 | 119 | 15 | 46 | 456 | 56 | 80 | 794 | 98 |
| 13 | 129 | 16 | 47 | 466 | 57 | 81 | 804 | 99 |
| 14 | 139 | 17 | 48 | 476 | 59 | 82 | 814 | 100 |
| 15 | 149 | 18 | 49 | 486 | 60 | 83 | 824 | 101 |
| 16 | 159 | 20 | 50 | 496 | 61 | 84 | 834 | 103 |
| 17 | 169 | 21 | 51 | 506 | 62 | 85 | 844 | 104 |
| 18 | 179 | 22 | 52 | 516 | 63 | 86 | 854 | 105 |
| 19 | 189 | 23 | 53 | 526 | 65 | 87 | 863 | 106 |
| 20 | 198 | 24 | 54 | 536 | 66 | 88 | 873 | 107 |
| 21 | 208 | 26 | 55 | 546 | 67 | 89 | 883 | 109 |
| 22 | 218 | 27 | 56 | 556 | 68 | 90 | 893 | 110 |
| 23 | 228 | 28 | 57 | 566 | 69 | 91 | 903 | 111 |
| 24 | 238 | 29 | 58 | 576 | 71 | 92 | 913 | 112 |
| 25 | 248 | 30 | 59 | 586 | 72 | 93 | 923 | 113 |
| 26 | 258 | 32 | 60 | 596 | 73 | 94 | 933 | 115 |
| 27 | 268 | 33 | 61 | 605 | 74 | 95 | 943 | 116 |
| 28 | 278 | 34 | 62 | 615 | 76 | 96 | 953 | 117 |
| 29 | 288 | 35 | 63 | 625 | 77 | 97 | 963 | 118 |
| 30 | 298 | 37 | 64 | 635 | 78 | 98 | 973 | 120 |
| 31 | 308 | 38 | 65 | 645 | 79 | 99 | 983 | 121 |
| 32 | 318 | 39 | 66 | 655 | 81 | 100 | 993 | 122 |
| 33 | 327 | 40 | 67 | 665 | 82 | 200 | 1985 | 244 |
| 34 | 337 | 41 | 68 | 675 | 83 | 300 | 2977 | 366 |

| M | 8 d. | 82d | M | 8 d. | 82d | Min. | 8 d. | 82 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 1 | 35 | 347 | 49 | 69 | 683 | 96 |
| 2 | 20 | 3 | 36 | 357 | 50 | 70 | 693 | 97 |
| 3 | 30 | 4 | 37 | 366 | 51 | 71 | 703 | 99 |
| 4 | 40 | 6 | 38 | 376 | 53 | 72 | 713 | 100 |
| 5 | 50 | 7 | 39 | 386 | 54 | 73 | 723 | 102 |
| 6 | 59 | 8 | 40 | 396 | 56 | 74 | 733 | 103 |
| 7 | 69 | 10 | 41 | 406 | 57 | 75 | 743 | 104 |
| 8 | 79 | 11 | 42 | 416 | 58 | 76 | 753 | 106 |
| 9 | 89 | 13 | 43 | 426 | 60 | 77 | 763 | 107 |
| 10 | 99 | 14 | 44 | 436 | 61 | 78 | 772 | 109 |
| 11 | 109 | 15 | 45 | 446 | 63 | 79 | 782 | 110 |
| 12 | 119 | 17 | 46 | 456 | 64 | 80 | 792 | 111 |
| 13 | 129 | 18 | 47 | 465 | 65 | 81 | 802 | 113 |
| 14 | 139 | 19 | 48 | 475 | 67 | 82 | 812 | 114 |
| 15 | 148 | 21 | 49 | 485 | 68 | 83 | 822 | 115 |
| 16 | 158 | 22 | 50 | 495 | 70 | 84 | 832 | 117 |
| 17 | 168 | 24 | 51 | 505 | 71 | 85 | 842 | 118 |
| 18 | 178 | 25 | 52 | 515 | 72 | 86 | 852 | 120 |
| 19 | 188 | 26 | 53 | 525 | 74 | 87 | 862 | 121 |
| 20 | 198 | 28 | 54 | 535 | 75 | 88 | 872 | 122 |
| 21 | 208 | 29 | 55 | 545 | 77 | 89 | 881 | 124 |
| 22 | 218 | 31 | 56 | 555 | 78 | 90 | 891 | 125 |
| 23 | 228 | 32 | 57 | 565 | 79 | 91 | 901 | 127 |
| 24 | 238 | 33 | 58 | 574 | 81 | 92 | 911 | 128 |
| 25 | 248 | 35 | 59 | 584 | 82 | 93 | 921 | 129 |
| 26 | 257 | 36 | 60 | 594 | 83 | 94 | 931 | 131 |
| 27 | 267 | 38 | 61 | 604 | 85 | 95 | 941 | 132 |
| 28 | 277 | 39 | 62 | 614 | 86 | 96 | 951 | 134 |
| 29 | 287 | 40 | 63 | 624 | 88 | 97 | 961 | 135 |
| 30 | 297 | 42 | 64 | 634 | 89 | 98 | 970 | 136 |
| 31 | 307 | 43 | 65 | 644 | 90 | 99 | 980 | 138 |
| 32 | 317 | 44 | 66 | 654 | 92 | 100 | 990 | 139 |
| 33 | 327 | 46 | 67 | 664 | 93 | 200 | 1981 | 278 |
| 34 | 337 | 47 | 68 | 673 | 95 | 300 | 2971 | 418 |

| M. | 9 d. | 81 d. | M. | 9 d. | 81 d. | Min. | 9 d. | 81 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 2 | 35 | 346 | 55 | 69 | 682 | 108 |
| 2 | 20 | 3 | 36 | 356 | 56 | 70 | 691 | 109 |
| 3 | 30 | 5 | 37 | 366 | 58 | 71 | 701 | 111 |
| 4 | 40 | 6 | 38 | 375 | 59 | 72 | 711 | 112 |
| 5 | 49 | 8 | 39 | 385 | 61 | 73 | 721 | 114 |
| 6 | 59 | 9 | 40 | 395 | 63 | 74 | 731 | 116 |
| 7 | 69 | 11 | 41 | 405 | 64 | 75 | 741 | 117 |
| 8 | 79 | 13 | 42 | 415 | 66 | 76 | 751 | 119 |
| 9 | 89 | 14 | 43 | 425 | 67 | 77 | 761 | 120 |
| 10 | 99 | 16 | 44 | 435 | 69 | 78 | 770 | 122 |
| 11 | 109 | 17 | 45 | 445 | 70 | 79 | 780 | 124 |
| 12 | 119 | 19 | 46 | 454 | 72 | 80 | 790 | 125 |
| 13 | 129 | 20 | 47 | 464 | 73 | 81 | 800 | 127 |
| 14 | 138 | 22 | 48 | 474 | 75 | 82 | 810 | 128 |
| 15 | 148 | 23 | 49 | 484 | 77 | 83 | 820 | 130 |
| 16 | 158 | 25 | 50 | 494 | 78 | 84 | 830 | 131 |
| 17 | 168 | 26 | 51 | 504 | 80 | 85 | 840 | 133 |
| 18 | 178 | 28 | 52 | 514 | 81 | 86 | 850 | 134 |
| 19 | 188 | 30 | 53 | 524 | 83 | 87 | 859 | 136 |
| 20 | 198 | 31 | 54 | 534 | 84 | 88 | 869 | 138 |
| 21 | 208 | 33 | 55 | 543 | 86 | 89 | 879 | 139 |
| 22 | 217 | 34 | 56 | 553 | 88 | 90 | 889 | 141 |
| 23 | 227 | 36 | 57 | 563 | 89 | 91 | 899 | 142 |
| 24 | 237 | 37 | 58 | 573 | 91 | 92 | 909 | 144 |
| 25 | 247 | 39 | 59 | 583 | 92 | 93 | 919 | 145 |
| 26 | 257 | 41 | 60 | 593 | 94 | 94 | 929 | 147 |
| 27 | 267 | 42 | 61 | 603 | 95 | 95 | 938 | 148 |
| 28 | 277 | 44 | 62 | 612 | 97 | 96 | 948 | 150 |
| 29 | 287 | 45 | 63 | 622 | 98 | 97 | 958 | 152 |
| 30 | 296 | 47 | 64 | 632 | 100 | 98 | 968 | 153 |
| 31 | 306 | 48 | 65 | 642 | 102 | 99 | 978 | 155 |
| 32 | 316 | 50 | 66 | 652 | 103 | 100 | 988 | 156 |
| 33 | 326 | 51 | 67 | 662 | 105 | 200 | 1975 | 313 |
| 34 | 336 | 53 | 68 | 672 | 106 | 300 | 2963 | 469 |

| M | 10d | 80 d. |
|---|---|---|
| 1 | 10 | 2 |
| 2 | 20 | 3 |
| 3 | 30 | 5 |
| 4 | 39 | 7 |
| 5 | 49 | 9 |
| 6 | 59 | 10 |
| 7 | 69 | 12 |
| 8 | 79 | 14 |
| 9 | 89 | 16 |
| 10 | 99 | 17 |
| 11 | 108 | 19 |
| 12 | 118 | 21 |
| 13 | 128 | 23 |
| 14 | 138 | 24 |
| 15 | 148 | 26 |
| 16 | 158 | 28 |
| 17 | 168 | 30 |
| 18 | 177 | 31 |
| 19 | 187 | 33 |
| 20 | 197 | 35 |
| 21 | 207 | 36 |
| 22 | 217 | 38 |
| 23 | 227 | 40 |
| 24 | 236 | 42 |
| 25 | 246 | 43 |
| 26 | 256 | 45 |
| 27 | 266 | 47 |
| 28 | 276 | 49 |
| 29 | 286 | 50 |
| 30 | 296 | 53 |
| 31 | 305 | 54 |
| 32 | 315 | 55 |
| 33 | 325 | 57 |
| 34 | 333 | 59 |
| 35 | 345 | 61 |
| 36 | 355 | 62 |
| 37 | 365 | 64 |
| 38 | 374 | 66 |
| 39 | 384 | 68 |
| 40 | 394 | 69 |
| 41 | 404 | 71 |
| 42 | 414 | 73 |
| 43 | 424 | 75 |
| 44 | 433 | 76 |
| 45 | 443 | 78 |
| 46 | 453 | 80 |
| 47 | 463 | 81 |
| 48 | 473 | 83 |
| 49 | 483 | 85 |
| 50 | 492 | 87 |
| 51 | 502 | 88 |
| 52 | 512 | 90 |
| 53 | 522 | 92 |
| 54 | 532 | 94 |
| 55 | 542 | 95 |
| 56 | 552 | 97 |
| 57 | 561 | 99 |
| 58 | 571 | 101 |
| 59 | 581 | 102 |
| 60 | 591 | 104 |
| 61 | 601 | 106 |
| 62 | 611 | 108 |
| 63 | 620 | 109 |
| 64 | 630 | 111 |
| 65 | 640 | 113 |
| 66 | 650 | 115 |
| 67 | 660 | 116 |
| 68 | 670 | 118 |

| Min. | 10 d. | 80 d. |
|---|---|---|
| 69 | 680 | 120 |
| 70 | 689 | 121 |
| 71 | 699 | 123 |
| 72 | 709 | 125 |
| 73 | 719 | 127 |
| 74 | 729 | 128 |
| 75 | 739 | 130 |
| 76 | 749 | 132 |
| 77 | 758 | 133 |
| 78 | 768 | 135 |
| 79 | 778 | 137 |
| 80 | 788 | 139 |
| 81 | 798 | 141 |
| 82 | 808 | 142 |
| 83 | 817 | 144 |
| 84 | 827 | 146 |
| 85 | 837 | 148 |
| 86 | 847 | 149 |
| 87 | 857 | 151 |
| 88 | 867 | 153 |
| 89 | 876 | 154 |
| 90 | 886 | 156 |
| 91 | 896 | 158 |
| 92 | 906 | 160 |
| 93 | 916 | 161 |
| 94 | 926 | 163 |
| 95 | 936 | 165 |
| 96 | 946 | 167 |
| 97 | 955 | 168 |
| 98 | 965 | 170 |
| 99 | 975 | 172 |
| 100 | 985 | 174 |
| 200 | 1970 | 347 |
| 300 | 2954 | 521 |

| M | 11d | 79 d. |
|---|---|---|
| 1 | 10 | 2 |
| 2 | 20 | 4 |
| 3 | 29 | 6 |
| 4 | 39 | 8 |
| 5 | 49 | 9 |
| 6 | 59 | 11 |
| 7 | 69 | 13 |
| 8 | 78 | 15 |
| 9 | 88 | 17 |
| 10 | 98 | 19 |
| 11 | 108 | 21 |
| 12 | 118 | 23 |
| 13 | 128 | 25 |
| 14 | 137 | 27 |
| 15 | 147 | 29 |
| 16 | 157 | 30 |
| 17 | 167 | 32 |
| 18 | 177 | 34 |
| 19 | 186 | 36 |
| 20 | 196 | 38 |
| 21 | 206 | 40 |
| 22 | 216 | 42 |
| 23 | 226 | 44 |
| 24 | 236 | 46 |
| 25 | 245 | 48 |
| 26 | 255 | 50 |
| 27 | 265 | 51 |
| 28 | 275 | 53 |
| 29 | 285 | 55 |
| 30 | 294 | 57 |
| 31 | 304 | 59 |
| 32 | 314 | 61 |
| 33 | 324 | 63 |
| 34 | 334 | 65 |

| M | 11d | 79d |
|---|---|---|
| 35 | 343 | 67 |
| 36 | 353 | 69 |
| 37 | 363 | 71 |
| 38 | 373 | 72 |
| 39 | 383 | 74 |
| 40 | 393 | 76 |
| 41 | 402 | 78 |
| 42 | 412 | 80 |
| 43 | 422 | 82 |
| 44 | 432 | 84 |
| 45 | 442 | 86 |
| 46 | 452 | 88 |
| 47 | 461 | 90 |
| 48 | 471 | 92 |
| 49 | 481 | 93 |
| 50 | 491 | 95 |
| 51 | 501 | 97 |
| 52 | 510 | 99 |
| 53 | 520 | 101 |
| 54 | 530 | 103 |
| 55 | 540 | 105 |
| 56 | 550 | 107 |
| 57 | 559 | 109 |
| 58 | 569 | 111 |
| 59 | 579 | 112 |
| 60 | 589 | 114 |
| 61 | 599 | 116 |
| 62 | 609 | 118 |
| 63 | 618 | 120 |
| 64 | 628 | 122 |
| 65 | 638 | 124 |
| 66 | 648 | 126 |
| 67 | 658 | 128 |
| 68 | 668 | 130 |

| Min. | 11 d. | 79 d. |
|---|---|---|
| 69 | 677 | 132 |
| 70 | 687 | 134 |
| 71 | 697 | 135 |
| 72 | 707 | 137 |
| 73 | 716 | 139 |
| 74 | 726 | 141 |
| 75 | 736 | 143 |
| 76 | 746 | 145 |
| 77 | 756 | 147 |
| 78 | 765 | 149 |
| 79 | 775 | 151 |
| 80 | 785 | 153 |
| 81 | 795 | 154 |
| 82 | 805 | 156 |
| 83 | 815 | 158 |
| 84 | 824 | 160 |
| 85 | 834 | 162 |
| 86 | 844 | 164 |
| 87 | 854 | 166 |
| 88 | 864 | 168 |
| 89 | 873 | 170 |
| 90 | 883 | 172 |
| 91 | 893 | 174 |
| 92 | 903 | 176 |
| 93 | 913 | 177 |
| 94 | 923 | 179 |
| 95 | 932 | 181 |
| 96 | 942 | 183 |
| 97 | 952 | 185 |
| 98 | 962 | 187 |
| 99 | 972 | 189 |
| 100 | 981 | 191 |
| 200 | 1963 | 382 |
| 300 | 2944 | 572 |

| M | 12d | 78 d. | M | 12d | 78d | Min. | 12 d. | 78 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 2 | 35 | 342 | 73 | 69 | 675 | 144 |
| 2 | 20 | 4 | 36 | 352 | 75 | 70 | 685 | 146 |
| 3 | 29 | 6 | 37 | 362 | 77 | 71 | 694 | 148 |
| 4 | 39 | 8 | 38 | 372 | 79 | 72 | 704 | 150 |
| 5 | 49 | 10 | 39 | 381 | 81 | 73 | 714 | 152 |
| 6 | 59 | 12 | 40 | 391 | 83 | 74 | 724 | 154 |
| 7 | 68 | 15 | 41 | 401 | 85 | 75 | 734 | 156 |
| 8 | 78 | 17 | 42 | 411 | 87 | 76 | 743 | 158 |
| 9 | 88 | 19 | 43 | 420 | 90 | 77 | 753 | 160 |
| 10 | 98 | 21 | 44 | 430 | 92 | 78 | 763 | 162 |
| 11 | 108 | 23 | 45 | 440 | 94 | 79 | 773 | 164 |
| 12 | 117 | 25 | 46 | 450 | 96 | 80 | 783 | 166 |
| 13 | 127 | 27 | 47 | 460 | 98 | 81 | 792 | 168 |
| 14 | 137 | 29 | 48 | 470 | 100 | 82 | 802 | 170 |
| 15 | 147 | 31 | 49 | 479 | 102 | 83 | 812 | 173 |
| 16 | 156 | 33 | 50 | 489 | 104 | 84 | 822 | 175 |
| 17 | 166 | 36 | 51 | 499 | 106 | 85 | 831 | 177 |
| 18 | 176 | 38 | 52 | 509 | 108 | 86 | 841 | 179 |
| 19 | 186 | 40 | 53 | 518 | 110 | 87 | 851 | 181 |
| 20 | 196 | 42 | 54 | 528 | 112 | 88 | 861 | 183 |
| 21 | 205 | 44 | 55 | 538 | 114 | 89 | 871 | 185 |
| 22 | 215 | 46 | 56 | 548 | 116 | 90 | 880 | 187 |
| 23 | 225 | 48 | 57 | 558 | 118 | 91 | 890 | 189 |
| 24 | 235 | 50 | 58 | 567 | 121 | 92 | 900 | 191 |
| 25 | 245 | 52 | 59 | 577 | 123 | 93 | 910 | 193 |
| 26 | 254 | 54 | 60 | 587 | 125 | 94 | 920 | 195 |
| 27 | 264 | 56 | 61 | 597 | 127 | 95 | 929 | 197 |
| 28 | 274 | 58 | 62 | 607 | 129 | 96 | 939 | 200 |
| 29 | 284 | 60 | 63 | 616 | 131 | 97 | 949 | 202 |
| 30 | 293 | 62 | 64 | 626 | 133 | 98 | 959 | 204 |
| 31 | 303 | 64 | 65 | 636 | 135 | 99 | 968 | 206 |
| 32 | 313 | 66 | 66 | 646 | 137 | 100 | 978 | 208 |
| 33 | 323 | 69 | 67 | 655 | 140 | 200 | 1956 | 416 |
| 34 | 333 | 71 | 68 | 665 | 142 | 300 | 2934 | 624 |

| M | 13d | 77 d. |
|---|---|---|
| 1 | 10 | 2 |
| 2 | 20 | 4 |
| 3 | 29 | 7 |
| 4 | 39 | 9 |
| 5 | 49 | 11 |
| 6 | 59 | 13 |
| 7 | 68 | 16 |
| 8 | 78 | 18 |
| 9 | 88 | 20 |
| 10 | 98 | 22 |
| 11 | 107 | 25 |
| 12 | 117 | 27 |
| 13 | 127 | 29 |
| 14 | 136 | 31 |
| 15 | 146 | 34 |
| 16 | 156 | 36 |
| 17 | 166 | 38 |
| 18 | 176 | 40 |
| 19 | 185 | 43 |
| 20 | 195 | 45 |
| 21 | 205 | 47 |
| 22 | 215 | 49 |
| 23 | 224 | 52 |
| 24 | 234 | 54 |
| 25 | 244 | 56 |
| 26 | 254 | 58 |
| 27 | 263 | 61 |
| 28 | 273 | 63 |
| 29 | 283 | 65 |
| 30 | 292 | 67 |
| 31 | 302 | 70 |
| 32 | 312 | 72 |
| 33 | 322 | 74 |
| 34 | 331 | 76 |

| M | 13d | 77d |
|---|---|---|
| 35 | 341 | 79 |
| 36 | 351 | 81 |
| 37 | 361 | 83 |
| 38 | 370 | 86 |
| 39 | 380 | 88 |
| 40 | 390 | 90 |
| 41 | 400 | 92 |
| 42 | 409 | 94 |
| 43 | 419 | 97 |
| 44 | 429 | 99 |
| 45 | 438 | 101 |
| 46 | 448 | 103 |
| 47 | 458 | 106 |
| 48 | 468 | 108 |
| 49 | 477 | 110 |
| 50 | 487 | 112 |
| 51 | 497 | 115 |
| 52 | 507 | 117 |
| 53 | 516 | 119 |
| 54 | 526 | 121 |
| 55 | 536 | 124 |
| 56 | 546 | 126 |
| 57 | 555 | 128 |
| 58 | 565 | 130 |
| 59 | 575 | 133 |
| 60 | 585 | 135 |
| 61 | 594 | 137 |
| 62 | 604 | 140 |
| 63 | 614 | 142 |
| 64 | 624 | 144 |
| 65 | 634 | 146 |
| 66 | 643 | 148 |
| 67 | 653 | 151 |
| 68 | 663 | 153 |

| Min. | 13 d. | 77 d. |
|---|---|---|
| 69 | 672 | 155 |
| 70 | 682 | 157 |
| 71 | 692 | 160 |
| 72 | 702 | 162 |
| 73 | 711 | 164 |
| 74 | 721 | 166 |
| 75 | 731 | 169 |
| 76 | 741 | 171 |
| 77 | 750 | 173 |
| 78 | 760 | 175 |
| 79 | 770 | 178 |
| 80 | 780 | 180 |
| 81 | 789 | 182 |
| 82 | 799 | 184 |
| 83 | 809 | 187 |
| 84 | 818 | 189 |
| 85 | 828 | 191 |
| 86 | 838 | 193 |
| 87 | 848 | 196 |
| 88 | 857 | 198 |
| 89 | 867 | 200 |
| 90 | 877 | 202 |
| 91 | 887 | 205 |
| 92 | 896 | 207 |
| 93 | 906 | 209 |
| 94 | 916 | 211 |
| 95 | 926 | 214 |
| 96 | 935 | 216 |
| 97 | 945 | 218 |
| 98 | 955 | 221 |
| 99 | 965 | 223 |
| 100 | 974 | 225 |
| 200 | 1949 | 450 |
| 300 | 2923 | 675 |

| M | 14d | 76 d |
|---|---|---|
| 1 | 10 | 2 |
| 2 | 19 | 5 |
| 3 | 29 | 7 |
| 4 | 39 | 10 |
| 5 | 48 | 12 |
| 6 | 58 | 14 |
| 7 | 68 | 17 |
| 8 | 78 | 19 |
| 9 | 87 | 22 |
| 10 | 97 | 24 |
| 11 | 107 | 27 |
| 12 | 116 | 29 |
| 13 | 126 | 31 |
| 14 | 136 | 34 |
| 15 | 146 | 36 |
| 16 | 155 | 39 |
| 17 | 165 | 41 |
| 18 | 175 | 44 |
| 19 | 184 | 46 |
| 20 | 194 | 48 |
| 21 | 204 | 51 |
| 22 | 213 | 53 |
| 23 | 223 | 56 |
| 24 | 233 | 58 |
| 25 | 242 | 60 |
| 26 | 252 | 63 |
| 27 | 262 | 65 |
| 28 | 272 | 68 |
| 29 | 281 | 70 |
| 30 | 291 | 73 |
| 31 | 301 | 75 |
| 32 | 310 | 77 |
| 33 | 320 | 80 |
| 34 | 330 | 82 |

| M | 14d | 76d |
|---|---|---|
| 35 | 340 | 85 |
| 36 | 349 | 87 |
| 37 | 359 | 90 |
| 38 | 369 | 92 |
| 39 | 378 | 94 |
| 40 | 388 | 97 |
| 41 | 398 | 99 |
| 42 | 407 | 102 |
| 43 | 417 | 104 |
| 44 | 427 | 107 |
| 45 | 437 | 109 |
| 46 | 446 | 111 |
| 47 | 456 | 114 |
| 48 | 466 | 116 |
| 49 | 475 | 119 |
| 50 | 485 | 121 |
| 51 | 495 | 123 |
| 52 | 504 | 126 |
| 53 | 514 | 128 |
| 54 | 524 | 131 |
| 55 | 534 | 133 |
| 56 | 543 | 136 |
| 57 | 553 | 138 |
| 58 | 563 | 140 |
| 59 | 572 | 143 |
| 60 | 582 | 145 |
| 61 | 592 | 148 |
| 62 | 601 | 150 |
| 63 | 611 | 153 |
| 64 | 621 | 155 |
| 65 | 631 | 157 |
| 66 | 640 | 160 |
| 67 | 650 | 162 |
| 68 | 660 | 165 |

| Min. | 14 d. | 76d. |
|---|---|---|
| 69 | 669 | 167 |
| 70 | 679 | 169 |
| 71 | 689 | 172 |
| 72 | 698 | 174 |
| 73 | 708 | 177 |
| 74 | 718 | 179 |
| 75 | 728 | 182 |
| 76 | 737 | 184 |
| 77 | 747 | 187 |
| 78 | 757 | 189 |
| 79 | 766 | 191 |
| 80 | 776 | 194 |
| 81 | 786 | 195 |
| 82 | 796 | 197 |
| 83 | 805 | 200 |
| 84 | 815 | 202 |
| 85 | 825 | 205 |
| 86 | 834 | 207 |
| 87 | 844 | 209 |
| 88 | 854 | 213 |
| 89 | 864 | 215 |
| 90 | 873 | 218 |
| 91 | 883 | 220 |
| 92 | 893 | 223 |
| 93 | 902 | 225 |
| 94 | 912 | 227 |
| 95 | 921 | 230 |
| 96 | 931 | 232 |
| 97 | 941 | 235 |
| 98 | 951 | 237 |
| 99 | 960 | 240 |
| 100 | 970 | 242 |
| 200 | 1941 | 484 |
| 300 | 2911 | 726 |

| M | 15 d | 75 d |
|---|---|---|
| 1 | 10 | 3 |
| 2 | 19 | 5 |
| 3 | 29 | 8 |
| 4 | 39 | 10 |
| 5 | 48 | 13 |
| 6 | 58 | 16 |
| 7 | 68 | 18 |
| 8 | 77 | 21 |
| 9 | 87 | 23 |
| 10 | 97 | 26 |
| 11 | 106 | 28 |
| 12 | 116 | 31 |
| 13 | 126 | 34 |
| 14 | 135 | 36 |
| 15 | 145 | 39 |
| 16 | 155 | 41 |
| 17 | 164 | 44 |
| 18 | 174 | 47 |
| 19 | 183 | 49 |
| 20 | 193 | 52 |
| 21 | 203 | 54 |
| 22 | 213 | 57 |
| 23 | 222 | 60 |
| 24 | 232 | 62 |
| 25 | 242 | 65 |
| 26 | 251 | 67 |
| 27 | 261 | 70 |
| 28 | 271 | 73 |
| 29 | 280 | 75 |
| 30 | 290 | 78 |
| 31 | 299 | 80 |
| 32 | 309 | 83 |
| 33 | 319 | 85 |
| 34 | 328 | 88 |
| 35 | 338 | 91 |
| 36 | 348 | 93 |
| 37 | 357 | 96 |
| 38 | 367 | 98 |
| 39 | 377 | 101 |
| 40 | 386 | 103 |
| 41 | 396 | 106 |
| 42 | 406 | 109 |
| 43 | 415 | 111 |
| 44 | 425 | 114 |
| 45 | 435 | 116 |
| 46 | 444 | 119 |
| 47 | 454 | 123 |
| 48 | 464 | 125 |
| 49 | 473 | 128 |
| 50 | 483 | 129 |
| 51 | 493 | 132 |
| 52 | 502 | 135 |
| 53 | 512 | 137 |
| 54 | 522 | 140 |
| 55 | 531 | 142 |
| 56 | 541 | 145 |
| 57 | 551 | 148 |
| 58 | 560 | 150 |
| 59 | 570 | 153 |
| 60 | 580 | 155 |
| 61 | 589 | 158 |
| 62 | 599 | 160 |
| 63 | 608 | 163 |
| 64 | 618 | 166 |
| 65 | 628 | 168 |
| 66 | 638 | 171 |
| 67 | 647 | 174 |
| 68 | 657 | 176 |

| Min. | 15 d. | 75 d. |
|---|---|---|
| 69 | 666 | 179 |
| 70 | 676 | 181 |
| 71 | 686 | 184 |
| 72 | 696 | 186 |
| 73 | 705 | 189 |
| 74 | 715 | 192 |
| 75 | 724 | 194 |
| 76 | 734 | 197 |
| 77 | 744 | 200 |
| 78 | 754 | 202 |
| 79 | 763 | 205 |
| 80 | 773 | 207 |
| 81 | 783 | 210 |
| 82 | 792 | 212 |
| 83 | 802 | 215 |
| 84 | 811 | 217 |
| 85 | 821 | 220 |
| 86 | 831 | 223 |
| 87 | 840 | 225 |
| 88 | 850 | 228 |
| 89 | 860 | 230 |
| 90 | 869 | 233 |
| 91 | 879 | 236 |
| 92 | 889 | 238 |
| 93 | 898 | 241 |
| 94 | 908 | 243 |
| 95 | 918 | 246 |
| 96 | 927 | 248 |
| 97 | 937 | 251 |
| 98 | 947 | 254 |
| 99 | 956 | 256 |
| 100 | 966 | 259 |
| 200 | 1932 | 518 |
| 300 | 2898 | 776 |

| M | 16d | 74 d. |
|---|---|---|
| 1 | 10 | 3 |
| 2 | 19 | 6 |
| 3 | 29 | 8 |
| 4 | 38 | 11 |
| 5 | 48 | 14 |
| 6 | 58 | 17 |
| 7 | 67 | 19 |
| 8 | 77 | 22 |
| 9 | 86 | 25 |
| 10 | 96 | 28 |
| 11 | 106 | 30 |
| 12 | 115 | 33 |
| 13 | 125 | 36 |
| 14 | 134 | 39 |
| 15 | 144 | 41 |
| 16 | 154 | 44 |
| 17 | 163 | 47 |
| 18 | 173 | 50 |
| 19 | 183 | 53 |
| 20 | 192 | 55 |
| 21 | 202 | 58 |
| 22 | 211 | 61 |
| 23 | 221 | 63 |
| 24 | 231 | 66 |
| 25 | 240 | 69 |
| 26 | 250 | 72 |
| 27 | 259 | 75 |
| 28 | 269 | 77 |
| 29 | 279 | 80 |
| 30 | 288 | 83 |
| 31 | 298 | 85 |
| 32 | 308 | 88 |
| 33 | 317 | 91 |
| 34 | 327 | 94 |

| M | 16d | 74d |
|---|---|---|
| 35 | 336 | 97 |
| 36 | 346 | 99 |
| 37 | 356 | 102 |
| 38 | 365 | 105 |
| 39 | 375 | 107 |
| 40 | 384 | 110 |
| 41 | 394 | 113 |
| 42 | 404 | 116 |
| 43 | 413 | 119 |
| 44 | 423 | 121 |
| 45 | 432 | 124 |
| 46 | 442 | 127 |
| 47 | 452 | 130 |
| 48 | 461 | 132 |
| 49 | 471 | 135 |
| 50 | 481 | 138 |
| 51 | 490 | 141 |
| 52 | 500 | 143 |
| 53 | 509 | 146 |
| 54 | 519 | 149 |
| 55 | 529 | 151 |
| 56 | 538 | 154 |
| 57 | 548 | 157 |
| 58 | 557 | 160 |
| 59 | 567 | 163 |
| 60 | 577 | 165 |
| 61 | 586 | 168 |
| 62 | 596 | 171 |
| 63 | 606 | 174 |
| 64 | 615 | 177 |
| 65 | 625 | 179 |
| 66 | 634 | 182 |
| 67 | 644 | 185 |
| 68 | 654 | 188 |

| Min. | 16 d. | 74 d. |
|---|---|---|
| 69 | 663 | 190 |
| 70 | 673 | 193 |
| 71 | 682 | 196 |
| 72 | 692 | 199 |
| 73 | 702 | 201 |
| 74 | 711 | 204 |
| 75 | 721 | 207 |
| 76 | 731 | 210 |
| 77 | 740 | 213 |
| 78 | 750 | 215 |
| 79 | 759 | 218 |
| 80 | 769 | 220 |
| 81 | 779 | 223 |
| 82 | 788 | 226 |
| 83 | 798 | 229 |
| 84 | 807 | 232 |
| 85 | 817 | 235 |
| 86 | 827 | 237 |
| 87 | 836 | 240 |
| 88 | 846 | 243 |
| 89 | 856 | 245 |
| 90 | 865 | 248 |
| 91 | 875 | 251 |
| 92 | 884 | 254 |
| 93 | 894 | 257 |
| 94 | 904 | 259 |
| 95 | 913 | 262 |
| 96 | 923 | 265 |
| 97 | 932 | 267 |
| 98 | 942 | 270 |
| 99 | 952 | 273 |
| 100 | 961 | 276 |
| 200 | 1923 | 551 |
| 300 | 2884 | 827 |

| M | 17d | 73d. |
|---|---|---|
| 1 | 10 | 3 |
| 2 | 19 | 6 |
| 3 | 29 | 9 |
| 4 | 38 | 12 |
| 5 | 48 | 15 |
| 6 | 57 | 17 |
| 7 | 67 | 20 |
| 8 | 76 | 23 |
| 9 | 86 | 26 |
| 10 | 96 | 29 |
| 11 | 105 | 32 |
| 12 | 115 | 35 |
| 13 | 124 | 38 |
| 14 | 134 | 41 |
| 15 | 143 | 44 |
| 16 | 153 | 47 |
| 17 | 162 | 50 |
| 18 | 172 | 52 |
| 19 | 182 | 55 |
| 20 | 191 | 58 |
| 21 | 201 | 61 |
| 22 | 210 | 64 |
| 23 | 220 | 67 |
| 24 | 230 | 70 |
| 25 | 239 | 73 |
| 26 | 249 | 76 |
| 27 | 258 | 79 |
| 28 | 268 | 82 |
| 29 | 277 | 85 |
| 30 | 287 | 88 |
| 31 | 296 | 91 |
| 32 | 306 | 93 |
| 33 | 316 | 96 |
| 34 | 325 | 99 |
| 35 | 335 | 102 |
| 36 | 344 | 105 |
| 37 | 354 | 108 |
| 38 | 363 | 111 |
| 39 | 373 | 114 |
| 40 | 383 | 117 |
| 41 | 392 | 120 |
| 42 | 402 | 123 |
| 43 | 411 | 126 |
| 44 | 421 | 129 |
| 45 | 430 | 131 |
| 46 | 440 | 134 |
| 47 | 449 | 137 |
| 48 | 459 | 140 |
| 49 | 469 | 143 |
| 50 | 478 | 146 |
| 51 | 488 | 149 |
| 52 | 497 | 152 |
| 53 | 507 | 155 |
| 54 | 516 | 158 |
| 55 | 526 | 161 |
| 56 | 535 | 164 |
| 57 | 545 | 167 |
| 58 | 554 | 170 |
| 59 | 564 | 172 |
| 60 | 574 | 175 |
| 61 | 583 | 178 |
| 62 | 593 | 181 |
| 63 | 602 | 184 |
| 64 | 612 | 187 |
| 65 | 622 | 190 |
| 66 | 631 | 193 |
| 67 | 641 | 196 |
| 68 | 650 | 199 |

| Min. | 17 d. | 73 d. |
|---|---|---|
| 69 | 660 | 202 |
| 70 | 669 | 205 |
| 71 | 679 | 207 |
| 72 | 688 | 210 |
| 73 | 698 | 213 |
| 74 | 708 | 216 |
| 75 | 717 | 219 |
| 76 | 727 | 222 |
| 77 | 736 | 225 |
| 78 | 746 | 228 |
| 79 | 755 | 231 |
| 80 | 765 | 234 |
| 81 | 775 | 237 |
| 82 | 784 | 240 |
| 83 | 794 | 243 |
| 84 | 803 | 246 |
| 85 | 813 | 248 |
| 86 | 822 | 251 |
| 87 | 832 | 254 |
| 88 | 842 | 257 |
| 89 | 851 | 260 |
| 90 | 861 | 263 |
| 91 | 870 | 266 |
| 92 | 880 | 269 |
| 93 | 889 | 272 |
| 94 | 899 | 275 |
| 95 | 908 | 278 |
| 96 | 918 | 281 |
| 97 | 927 | 284 |
| 98 | 937 | 287 |
| 99 | 947 | 289 |
| 100 | 956 | 292 |
| 200 | 1913 | 585 |
| 300 | 2869 | 877 |

| M | 18 d | 72 d. | M | 18 d | 72 d | Min. | 81 d. | 72 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 3 | 35 | 333 | 108 | 69 | 656 | 213 |
| 2 | 19 | 6 | 36 | 342 | 111 | 70 | 666 | 216 |
| 3 | 28 | 9 | 37 | 352 | 114 | 71 | 675 | 219 |
| 4 | 38 | 12 | 38 | 361 | 117 | 72 | 685 | 222 |
| 5 | 47 | 15 | 39 | 371 | 120 | 73 | 694 | 225 |
| 6 | 57 | 18 | 40 | 380 | 124 | 74 | 704 | 229 |
| 7 | 66 | 22 | 41 | 390 | 127 | 75 | 713 | 232 |
| 8 | 76 | 25 | 42 | 399 | 130 | 76 | 723 | 235 |
| 9 | 85 | 28 | 43 | 409 | 133 | 77 | 732 | 238 |
| 10 | 95 | 31 | 44 | 418 | 136 | 78 | 742 | 241 |
| 11 | 104 | 34 | 45 | 428 | 139 | 79 | 751 | 244 |
| 12 | 114 | 37 | 46 | 437 | 142 | 80 | 761 | 247 |
| 13 | 123 | 40 | 47 | 447 | 145 | 81 | 770 | 250 |
| 14 | 133 | 43 | 48 | 456 | 148 | 82 | 780 | 253 |
| 15 | 142 | 46 | 49 | 466 | 151 | 83 | 789 | 256 |
| 16 | 152 | 50 | 50 | 475 | 154 | 84 | 799 | 260 |
| 17 | 161 | 53 | 51 | 485 | 158 | 85 | 808 | 263 |
| 18 | 171 | 56 | 52 | 495 | 161 | 86 | 818 | 266 |
| 19 | 180 | 59 | 53 | 504 | 164 | 87 | 827 | 269 |
| 20 | 190 | 62 | 54 | 514 | 167 | 88 | 837 | 272 |
| 21 | 200 | 65 | 55 | 523 | 170 | 89 | 846 | 275 |
| 22 | 209 | 68 | 56 | 533 | 173 | 90 | 856 | 278 |
| 23 | 219 | 71 | 57 | 542 | 176 | 91 | 865 | 281 |
| 24 | 228 | 74 | 58 | 552 | 179 | 92 | 875 | 284 |
| 25 | 238 | 77 | 59 | 561 | 182 | 93 | 884 | 287 |
| 26 | 247 | 81 | 60 | 571 | 185 | 94 | 894 | 290 |
| 27 | 257 | 84 | 61 | 580 | 188 | 95 | 903 | 293 |
| 28 | 266 | 87 | 62 | 590 | 192 | 96 | 913 | 297 |
| 29 | 276 | 90 | 63 | 599 | 195 | 97 | 922 | 300 |
| 30 | 285 | 93 | 64 | 609 | 198 | 98 | 932 | 303 |
| 31 | 295 | 96 | 65 | 618 | 201 | 99 | 941 | 306 |
| 32 | 304 | 99 | 66 | 628 | 204 | 100 | 951 | 309 |
| 33 | 314 | 102 | 67 | 637 | 207 | 200 | 1902 | 618 |
| 34 | 323 | 105 | 68 | 647 | 210 | 300 | 2853 | 927 |

| M | 19 d | 71 d. | M | 19d | 71d | Min. | 19 d. | 71 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 9 | 3 | 35 | 331 | 114 | 69 | 652 | 225 |
| 2 | 19 | 6 | 36 | 340 | 117 | 70 | 662 | 228 |
| 3 | 28 | 10 | 37 | 350 | 121 | 71 | 671 | 231 |
| 4 | 38 | 13 | 38 | 359 | 124 | 72 | 681 | 234 |
| 5 | 47 | 16 | 39 | 369 | 127 | 73 | 690 | 238 |
| 6 | 57 | 20 | 40 | 378 | 130 | 74 | 699 | 241 |
| 7 | 66 | 23 | 41 | 388 | 134 | 75 | 709 | 244 |
| 8 | 75 | 26 | 42 | 397 | 137 | 76 | 718 | 247 |
| 9 | 85 | 29 | 43 | 407 | 140 | 77 | 728 | 251 |
| 10 | 94 | 33 | 44 | 416 | 144 | 78 | 737 | 254 |
| 11 | 104 | 36 | 45 | 425 | 147 | 79 | 747 | 257 |
| 12 | 113 | 39 | 46 | 435 | 150 | 80 | 756 | 261 |
| 13 | 123 | 42 | 47 | 444 | 153 | 81 | 766 | 264 |
| 14 | 132 | 46 | 48 | 454 | 156 | 82 | 775 | 267 |
| 15 | 142 | 49 | 49 | 463 | 160 | 83 | 785 | 270 |
| 16 | 151 | 52 | 50 | 473 | 163 | 84 | 794 | 274 |
| 17 | 161 | 55 | 51 | 482 | 166 | 85 | 804 | 277 |
| 18 | 170 | 59 | 52 | 492 | 169 | 86 | 813 | 280 |
| 19 | 180 | 62 | 53 | 501 | 173 | 87 | 822 | 283 |
| 20 | 189 | 65 | 54 | 510 | 176 | 88 | 832 | 287 |
| 21 | 199 | 68 | 55 | 520 | 179 | 89 | 841 | 290 |
| 22 | 208 | 72 | 56 | 529 | 182 | 90 | 851 | 293 |
| 23 | 217 | 75 | 57 | 539 | 186 | 91 | 860 | 296 |
| 24 | 227 | 78 | 58 | 548 | 189 | 92 | 870 | 300 |
| 25 | 236 | 82 | 59 | 558 | 192 | 93 | 879 | 303 |
| 26 | 246 | 85 | 60 | 567 | 195 | 94 | 889 | 306 |
| 27 | 255 | 88 | 61 | 577 | 199 | 95 | 898 | 309 |
| 28 | 265 | 91 | 62 | 586 | 202 | 96 | 908 | 313 |
| 29 | 274 | 94 | 63 | 596 | 205 | 97 | 917 | 316 |
| 30 | 284 | 98 | 64 | 605 | 208 | 98 | 926 | 319 |
| 31 | 293 | 101 | 65 | 615 | 212 | 99 | 936 | 322 |
| 32 | 303 | 104 | 66 | 624 | 215 | 100 | 945 | 326 |
| 33 | 312 | 107 | 67 | 634 | 218 | 200 | 1891 | 651 |
| 34 | 321 | 111 | 68 | 643 | 222 | 300 | 2836 | 977 |

| M | 20d | 70d |
|---|---|---|
| 1 | 9 | 3 |
| 2 | 19 | 7 |
| 3 | 28 | 10 |
| 4 | 38 | 14 |
| 5 | 47 | 17 |
| 6 | 56 | 20 |
| 7 | 66 | 24 |
| 8 | 75 | 27 |
| 9 | 85 | 31 |
| 10 | 94 | 34 |
| 11 | 103 | 38 |
| 12 | 113 | 41 |
| 13 | 122 | 44 |
| 14 | 132 | 48 |
| 15 | 141 | 51 |
| 16 | 150 | 55 |
| 17 | 160 | 58 |
| 18 | 169 | 61 |
| 19 | 179 | 65 |
| 20 | 188 | 68 |
| 21 | 197 | 72 |
| 22 | 207 | 75 |
| 23 | 216 | 79 |
| 24 | 226 | 82 |
| 25 | 235 | 85 |
| 26 | 244 | 89 |
| 27 | 254 | 92 |
| 28 | 263 | 96 |
| 29 | 272 | 100 |
| 30 | 282 | 103 |
| 31 | 291 | 106 |
| 32 | 301 | 109 |
| 33 | 310 | 113 |
| 34 | 319 | 116 |

| M | 20d | 70d |
|---|---|---|
| 35 | 329 | 120 |
| 36 | 338 | 123 |
| 37 | 348 | 126 |
| 38 | 357 | 130 |
| 39 | 366 | 133 |
| 40 | 376 | 137 |
| 41 | 385 | 140 |
| 42 | 395 | 144 |
| 43 | 404 | 147 |
| 44 | 413 | 150 |
| 45 | 423 | 154 |
| 46 | 432 | 157 |
| 47 | 442 | 161 |
| 48 | 451 | 164 |
| 49 | 460 | 168 |
| 50 | 470 | 171 |
| 51 | 479 | 174 |
| 52 | 489 | 178 |
| 53 | 498 | 181 |
| 54 | 507 | 185 |
| 55 | 517 | 188 |
| 56 | 526 | 191 |
| 57 | 536 | 195 |
| 58 | 545 | 198 |
| 59 | 554 | 202 |
| 60 | 564 | 205 |
| 61 | 573 | 209 |
| 62 | 583 | 212 |
| 63 | 592 | 215 |
| 64 | 601 | 219 |
| 65 | 611 | 222 |
| 66 | 620 | 226 |
| 67 | 630 | 229 |
| 68 | 639 | 233 |

| Min. | 20 d. | 70 d. |
|---|---|---|
| 69 | 648 | 236 |
| 70 | 658 | 239 |
| 71 | 667 | 243 |
| 72 | 677 | 246 |
| 73 | 686 | 250 |
| 74 | 695 | 253 |
| 75 | 705 | 256 |
| 76 | 714 | 260 |
| 77 | 724 | 265 |
| 78 | 733 | 267 |
| 79 | 742 | 270 |
| 80 | 752 | 274 |
| 81 | 761 | 277 |
| 82 | 771 | 280 |
| 83 | 780 | 284 |
| 84 | 789 | 287 |
| 85 | 800 | 291 |
| 86 | 808 | 294 |
| 87 | 818 | 298 |
| 88 | 827 | 301 |
| 89 | 836 | 304 |
| 90 | 846 | 308 |
| 91 | 855 | 311 |
| 92 | 864 | 315 |
| 93 | 874 | 318 |
| 94 | 883 | 321 |
| 95 | 893 | 325 |
| 96 | 902 | 328 |
| 97 | 912 | 332 |
| 98 | 921 | 335 |
| 99 | 930 | 339 |
| 100 | 940 | 342 |
| 200 | 1879 | 684 |
| 300 | 2819 | 1026 |

| M | 21d | 69d |
|---|---|---|
| 1 | 9 | 4 |
| 2 | 19 | 7 |
| 3 | 28 | 11 |
| 4 | 37 | 14 |
| 5 | 47 | 18 |
| 6 | 56 | 21 |
| 7 | 65 | 25 |
| 8 | 75 | 29 |
| 9 | 84 | 32 |
| 10 | 93 | 36 |
| 11 | 103 | 39 |
| 12 | 112 | 43 |
| 13 | 121 | 47 |
| 14 | 131 | 50 |
| 15 | 140 | 54 |
| 16 | 149 | 57 |
| 17 | 159 | 61 |
| 18 | 168 | 64 |
| 19 | 177 | 68 |
| 20 | 187 | 72 |
| 21 | 196 | 75 |
| 22 | 205 | 79 |
| 23 | 215 | 82 |
| 24 | 224 | 86 |
| 25 | 233 | 90 |
| 26 | 243 | 93 |
| 27 | 252 | 97 |
| 28 | 261 | 100 |
| 29 | 271 | 104 |
| 30 | 280 | 107 |
| 31 | 289 | 111 |
| 32 | 299 | 115 |
| 33 | 308 | 118 |
| 34 | 317 | 122 |

| M | 21d | 69d |
|---|---|---|
| 35 | 327 | 125 |
| 36 | 336 | 129 |
| 37 | 345 | 132 |
| 38 | 355 | 136 |
| 39 | 364 | 140 |
| 40 | 373 | 143 |
| 41 | 383 | 147 |
| 42 | 392 | 150 |
| 43 | 401 | 154 |
| 44 | 411 | 158 |
| 45 | 420 | 161 |
| 45 | 429 | 165 |
| 47 | 439 | 168 |
| 48 | 448 | 172 |
| 49 | 457 | 176 |
| 50 | 467 | 179 |
| 51 | 476 | 183 |
| 52 | 485 | 186 |
| 53 | 495 | 190 |
| 54 | 504 | 193 |
| 55 | 513 | 197 |
| 56 | 523 | 201 |
| 57 | 532 | 204 |
| 58 | 541 | 208 |
| 59 | 551 | 211 |
| 60 | 560 | 215 |
| 61 | 569 | 219 |
| 62 | 579 | 222 |
| 63 | 588 | 226 |
| 64 | 598 | 229 |
| 65 | 607 | 233 |
| 66 | 616 | 236 |
| 67 | 626 | 240 |
| 68 | 635 | 244 |

| Min. | 21 d. | 69 d. |
|---|---|---|
| 69 | 644 | 247 |
| 70 | 653 | 251 |
| 71 | 663 | 254 |
| 72 | 672 | 258 |
| 73 | 681 | 262 |
| 74 | 691 | 265 |
| 75 | 700 | 269 |
| 76 | 709 | 272 |
| 77 | 719 | 276 |
| 78 | 728 | 279 |
| 79 | 737 | 283 |
| 80 | 747 | 287 |
| 81 | 756 | 290 |
| 82 | 766 | 294 |
| 83 | 775 | 297 |
| 84 | 784 | 301 |
| 85 | 794 | 305 |
| 86 | 803 | 308 |
| 87 | 812 | 312 |
| 88 | 822 | 315 |
| 89 | 831 | 319 |
| 90 | 840 | 323 |
| 91 | 849 | 326 |
| 92 | 859 | 330 |
| 93 | 868 | 333 |
| 94 | 877 | 337 |
| 95 | 887 | 340 |
| 96 | 896 | 344 |
| 97 | 905 | 348 |
| 98 | 915 | 351 |
| 99 | 924 | 355 |
| 100 | 934 | 358 |
| 200 | 1867 | 717 |
| 300 | 2801 | 1075 |

| M | 22d | 68 d. |
|---|---|---|
| 1 | 9 | 4 |
| 2 | 19 | 7 |
| 3 | 28 | 11 |
| 4 | 37 | 15 |
| 5 | 46 | 19 |
| 6 | 56 | 22 |
| 7 | 65 | 26 |
| 8 | 74 | 30 |
| 9 | 83 | 34 |
| 10 | 93 | 37 |
| 11 | 102 | 41 |
| 12 | 111 | 45 |
| 13 | 120 | 49 |
| 14 | 130 | 52 |
| 15 | 139 | 56 |
| 16 | 148 | 60 |
| 17 | 157 | 64 |
| 18 | 167 | 67 |
| 19 | 176 | 71 |
| 20 | 185 | 75 |
| 21 | 195 | 79 |
| 22 | 204 | 82 |
| 23 | 213 | 86 |
| 24 | 222 | 90 |
| 25 | 232 | 94 |
| 26 | 241 | 97 |
| 27 | 250 | 101 |
| 28 | 260 | 105 |
| 29 | 269 | 109 |
| 30 | 278 | 112 |
| 31 | 287 | 116 |
| 32 | 297 | 120 |
| 33 | 306 | 124 |
| 34 | 315 | 127 |

| M | 22d | 68d |
|---|---|---|
| 35 | 324 | 131 |
| 36 | 334 | 135 |
| 37 | 342 | 139 |
| 38 | 352 | 142 |
| 39 | 361 | 145 |
| 40 | 371 | 150 |
| 41 | 380 | 154 |
| 42 | 389 | 157 |
| 43 | 399 | 161 |
| 44 | 408 | 165 |
| 45 | 417 | 169 |
| 46 | 426 | 172 |
| 47 | 436 | 176 |
| 48 | 445 | 180 |
| 49 | 454 | 184 |
| 50 | 464 | 187 |
| 51 | 473 | 191 |
| 52 | 482 | 195 |
| 53 | 491 | 199 |
| 54 | 501 | 202 |
| 55 | 510 | 206 |
| 56 | 519 | 210 |
| 57 | 529 | 214 |
| 58 | 538 | 217 |
| 59 | 547 | 221 |
| 60 | 556 | 225 |
| 61 | 566 | 229 |
| 62 | 575 | 232 |
| 63 | 584 | 236 |
| 64 | 594 | 240 |
| 65 | 603 | 244 |
| 66 | 612 | 247 |
| 67 | 621 | 251 |
| 68 | 631 | 255 |

| Min. | 22 d. | 68 d. |
|---|---|---|
| 69 | 640 | 259 |
| 70 | 649 | 262 |
| 71 | 658 | 266 |
| 72 | 667 | 270 |
| 73 | 677 | 274 |
| 74 | 686 | 277 |
| 75 | 695 | 281 |
| 76 | 705 | 285 |
| 77 | 714 | 289 |
| 78 | 723 | 292 |
| 79 | 733 | 296 |
| 80 | 742 | 300 |
| 81 | 751 | 304 |
| 82 | 760 | 307 |
| 83 | 770 | 311 |
| 84 | 779 | 315 |
| 85 | 788 | 319 |
| 86 | 797 | 322 |
| 87 | 806 | 326 |
| 88 | 816 | 330 |
| 89 | 825 | 314 |
| 90 | 834 | 337 |
| 91 | 844 | 341 |
| 92 | 853 | 345 |
| 93 | 862 | 349 |
| 94 | 871 | 352 |
| 95 | 881 | 356 |
| 96 | 890 | 360 |
| 97 | 899 | 364 |
| 98 | 909 | 367 |
| 99 | 918 | 371 |
| 100 | 927 | 375 |
| 200 | 1854 | 749 |
| 300 | 2782 | 1094 |

| M | 23d | 67 d. |
|---|---|---|
| 1 | 9 | 4 |
| 2 | 18 | 8 |
| 3 | 28 | 12 |
| 4 | 37 | 16 |
| 5 | 46 | 19 |
| 6 | 55 | 23 |
| 7 | 64 | 27 |
| 8 | 74 | 31 |
| 9 | 83 | 35 |
| 10 | 92 | 39 |
| 11 | 101 | 43 |
| 12 | 110 | 47 |
| 13 | 120 | 51 |
| 14 | 129 | 55 |
| 15 | 138 | 59 |
| 16 | 147 | 62 |
| 17 | 156 | 66 |
| 18 | 166 | 70 |
| 19 | 175 | 74 |
| 20 | 184 | 78 |
| 21 | 193 | 82 |
| 22 | 202 | 86 |
| 23 | 212 | 90 |
| 24 | 221 | 94 |
| 25 | 230 | 98 |
| 26 | 239 | 102 |
| 27 | 248 | 105 |
| 28 | 258 | 109 |
| 29 | 267 | 113 |
| 30 | 276 | 117 |
| 31 | 285 | 121 |
| 32 | 294 | 125 |
| 33 | 304 | 129 |
| 34 | 313 | 133 |

| M | 23d | 67d |
|---|---|---|
| 35 | 322 | 137 |
| 36 | 331 | 141 |
| 37 | 340 | 144 |
| 38 | 350 | 148 |
| 39 | 359 | 152 |
| 40 | 368 | 156 |
| 41 | 377 | 160 |
| 42 | 386 | 164 |
| 43 | 396 | 168 |
| 44 | 405 | 172 |
| 45 | 414 | 176 |
| 46 | 423 | 180 |
| 47 | 433 | 184 |
| 48 | 442 | 187 |
| 49 | 451 | 191 |
| 50 | 460 | 195 |
| 51 | 469 | 199 |
| 52 | 479 | 203 |
| 53 | 488 | 207 |
| 54 | 497 | 211 |
| 55 | 506 | 215 |
| 56 | 515 | 219 |
| 57 | 524 | 223 |
| 58 | 534 | 226 |
| 59 | 543 | 230 |
| 60 | 552 | 234 |
| 61 | 561 | 238 |
| 62 | 571 | 242 |
| 63 | 580 | 1246 |
| 64 | 589 | 250 |
| 65 | 598 | 254 |
| 66 | 608 | 258 |
| 67 | 618 | 262 |
| 68 | 626 | 266 |

| Min. | 23 d. | 67 d. |
|---|---|---|
| 69 | 635 | 269 |
| 70 | 644 | 273 |
| 71 | 653 | 277 |
| 72 | 663 | 281 |
| 73 | 672 | 285 |
| 74 | 681 | 289 |
| 75 | 690 | 293 |
| 76 | 699 | 297 |
| 77 | 709 | 301 |
| 78 | 718 | 305 |
| 79 | 727 | 308 |
| 80 | 736 | 312 |
| 81 | 746 | 316 |
| 82 | 755 | 320 |
| 83 | 764 | 324 |
| 84 | 773 | 328 |
| 85 | 782 | 332 |
| 86 | 792 | 336 |
| 87 | 801 | 340 |
| 88 | 810 | 344 |
| 89 | 819 | 348 |
| 90 | 828 | 352 |
| 91 | 838 | 356 |
| 92 | 847 | 360 |
| 93 | 856 | 363 |
| 94 | 865 | 367 |
| 95 | 874 | 370 |
| 96 | 884 | 375 |
| 97 | 893 | 379 |
| 98 | 902 | 383 |
| 99 | 911 | 387 |
| 100 | 920 | 391 |
| 200 | 1841 | 781 |
| 300 | 2761 | 1172 |

| M | 24d | 66 d |
|---|---|---|
| 1 | 9 | 4 |
| 2 | 18 | 8 |
| 3 | 27 | 12 |
| 4 | 36 | 16 |
| 5 | 46 | 20 |
| 6 | 55 | 24 |
| 7 | 64 | 28 |
| 8 | 73 | 32 |
| 9 | 82 | 37 |
| 10 | 91 | 41 |
| 11 | 100 | 45 |
| 12 | 109 | 49 |
| 13 | 119 | 53 |
| 14 | 128 | 57 |
| 15 | 137 | 61 |
| 16 | 146 | 65 |
| 17 | 155 | 69 |
| 18 | 164 | 73 |
| 19 | 173 | 77 |
| 20 | 183 | 81 |
| 21 | 192 | 85 |
| 22 | 201 | 90 |
| 23 | 210 | 94 |
| 24 | 219 | 98 |
| 25 | 228 | 102 |
| 26 | 237 | 106 |
| 27 | 246 | 110 |
| 28 | 256 | 113 |
| 29 | 265 | 117 |
| 30 | 274 | 122 |
| 31 | 283 | 126 |
| 32 | 292 | 130 |
| 33 | 301 | 134 |
| 34 | 310 | 138 |

| M | 24d | 66d |
|---|---|---|
| 35 | 320 | 142 |
| 36 | 329 | 146 |
| 37 | 338 | 151 |
| 38 | 347 | 155 |
| 39 | 356 | 159 |
| 40 | 365 | 163 |
| 41 | 374 | 167 |
| 42 | 384 | 171 |
| 43 | 393 | 175 |
| 44 | 402 | 179 |
| 45 | 411 | 183 |
| 46 | 420 | 187 |
| 47 | 429 | 191 |
| 48 | 438 | 195 |
| 49 | 448 | 199 |
| 50 | 457 | 203 |
| 51 | 466 | 207 |
| 52 | 475 | 211 |
| 53 | 484 | 216 |
| 54 | 493 | 220 |
| 55 | 502 | 224 |
| 56 | 511 | 228 |
| 57 | 521 | 232 |
| 58 | 530 | 236 |
| 59 | 539 | 240 |
| 60 | 548 | 244 |
| 61 | 557 | 248 |
| 62 | 566 | 252 |
| 63 | 575 | 256 |
| 64 | 585 | 260 |
| 65 | 594 | 264 |
| 66 | 603 | 268 |
| 67 | 612 | 272 |
| 68 | 621 | 276 |

| Min. | 24 d. | 66 d. |
|---|---|---|
| 69 | 630 | 281 |
| 70 | 639 | 285 |
| 71 | 648 | 289 |
| 72 | 658 | 293 |
| 73 | 667 | 297 |
| 74 | 676 | 301 |
| 75 | 685 | 305 |
| 76 | 694 | 309 |
| 77 | 703 | 313 |
| 78 | 712 | 317 |
| 79 | 721 | 321 |
| 80 | 731 | 325 |
| 81 | 740 | 329 |
| 82 | 749 | 333 |
| 83 | 758 | 337 |
| 84 | 767 | 341 |
| 85 | 776 | 345 |
| 86 | 785 | 349 |
| 87 | 795 | 353 |
| 88 | 804 | 357 |
| 89 | 813 | 362 |
| 90 | 822 | 366 |
| 91 | 831 | 370 |
| 92 | 840 | 374 |
| 93 | 849 | 378 |
| 94 | 858 | 382 |
| 95 | 868 | 386 |
| 96 | 877 | 390 |
| 97 | 886 | 393 |
| 98 | 895 | 399 |
| 99 | 904 | 403 |
| 100 | 913 | 407 |
| 200 | 1827 | 813 |
| 300 | 2740 | 1220 |

| M | 25 d. | 65 d. |
|---|---|---|
| 1 | 9 | 4 |
| 2 | 18 | 8 |
| 3 | 27 | 13 |
| 4 | 36 | 17 |
| 5 | 45 | 21 |
| 6 | 54 | 25 |
| 7 | 63 | 30 |
| 8 | 72 | 34 |
| 9 | 81 | 38 |
| 10 | 91 | 42 |
| 11 | 100 | 47 |
| 12 | 109 | 51 |
| 13 | 118 | 55 |
| 14 | 127 | 59 |
| 15 | 136 | 63 |
| 16 | 145 | 68 |
| 17 | 154 | 72 |
| 18 | 163 | 76 |
| 19 | 172 | 80 |
| 20 | 181 | 84 |
| 21 | 190 | 89 |
| 22 | 199 | 93 |
| 23 | 208 | 97 |
| 24 | 218 | 101 |
| 25 | 227 | 106 |
| 26 | 236 | 110 |
| 27 | 245 | 114 |
| 28 | 254 | 118 |
| 29 | 263 | 123 |
| 30 | 272 | 127 |
| 31 | 281 | 131 |
| 32 | 290 | 135 |
| 33 | 299 | 140 |
| 34 | 308 | 144 |
| 35 | 317 | 148 |
| 36 | 326 | 152 |
| 37 | 335 | 156 |
| 38 | 344 | 161 |
| 39 | 353 | 165 |
| 40 | 362 | 169 |
| 41 | 372 | 173 |
| 42 | 381 | 178 |
| 43 | 390 | 182 |
| 44 | 399 | 186 |
| 45 | 408 | 190 |
| 46 | 417 | 195 |
| 47 | 426 | 199 |
| 48 | 435 | 203 |
| 49 | 444 | 207 |
| 50 | 453 | 211 |
| 51 | 462 | 216 |
| 52 | 471 | 220 |
| 53 | 480 | 224 |
| 54 | 489 | 228 |
| 55 | 498 | 232 |
| 56 | 507 | 237 |
| 57 | 516 | 241 |
| 58 | 526 | 245 |
| 59 | 535 | 250 |
| 60 | 544 | 254 |
| 61 | 553 | 258 |
| 62 | 562 | 262 |
| 63 | 571 | 267 |
| 64 | 580 | 271 |
| 65 | 589 | 275 |
| 66 | 598 | 279 |
| 67 | 607 | 283 |
| 68 | 616 | 288 |

| Min. | 25 d. | 65 d. |
|---|---|---|
| 69 | 625 | 292 |
| 70 | 634 | 296 |
| 71 | 643 | 300 |
| 72 | 652 | 305 |
| 73 | 662 | 309 |
| 74 | 671 | 313 |
| 75 | 680 | 317 |
| 76 | 689 | 321 |
| 77 | 698 | 326 |
| 78 | 707 | 330 |
| 79 | 716 | 334 |
| 80 | 725 | 338 |
| 81 | 734 | 343 |
| 82 | 743 | 347 |
| 83 | 752 | 351 |
| 84 | 761 | 355 |
| 85 | 770 | 360 |
| 86 | 779 | 364 |
| 87 | 788 | 368 |
| 88 | 797 | 372 |
| 89 | 807 | 376 |
| 90 | 816 | 380 |
| 91 | 825 | 384 |
| 92 | 834 | 389 |
| 93 | 843 | 393 |
| 94 | 852 | 397 |
| 95 | 861 | 401 |
| 96 | 870 | 406 |
| 97 | 879 | 410 |
| 98 | 888 | 414 |
| 99 | 897 | 418 |
| 100 | 906 | 423 |
| 200 | 1813 | 845 |
| 300 | 2719 | 1268 |

| M | 26d | 64d | M | 26d | 64d | Min. | 26 d. | 64 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 9 | 4 | 35 | 315 | 153 | 69 | 620 | 302 |
| 2 | 18 | 9 | 36 | 324 | 158 | 70 | 629 | 307 |
| 3 | 27 | 13 | 37 | 333 | 162 | 71 | 638 | 311 |
| 4 | 36 | 18 | 38 | 342 | 166 | 72 | 647 | 316 |
| 5 | 45 | 22 | 39 | 351 | 171 | 73 | 656 | 320 |
| 6 | 54 | 26 | 40 | 360 | 175 | 74 | 665 | 324 |
| 7 | 63 | 31 | 41 | 368 | 179 | 75 | 674 | 329 |
| 8 | 72 | 35 | 42 | 378 | 184 | 76 | 683 | 333 |
| 9 | 81 | 39 | 43 | 386 | 188 | 77 | 692 | 338 |
| 10 | 90 | 44 | 44 | 395 | 193 | 78 | 701 | 342 |
| 11 | 99 | 48 | 45 | 404 | 197 | 79 | 710 | 346 |
| 12 | 108 | 53 | 46 | 413 | 202 | 80 | 719 | 351 |
| 13 | 117 | 57 | 47 | 422 | 206 | 81 | 728 | 355 |
| 14 | 126 | 61 | 48 | 431 | 210 | 82 | 737 | 359 |
| 15 | 135 | 66 | 49 | 440 | 214 | 83 | 746 | 364 |
| 16 | 144 | 70 | 50 | 449 | 219 | 84 | 755 | 368 |
| 17 | 153 | 74 | 51 | 458 | 223 | 85 | 764 | 372 |
| 18 | 162 | 79 | 52 | 467 | 228 | 86 | 773 | 377 |
| 19 | 171 | 83 | 53 | 476 | 232 | 87 | 782 | 381 |
| 20 | 180 | 88 | 54 | 485 | 237 | 88 | 791 | 385 |
| 21 | 189 | 92 | 55 | 494 | 241 | 89 | 800 | 390 |
| 22 | 198 | 96 | 56 | 503 | 245 | 90 | 809 | 394 |
| 23 | 207 | 101 | 57 | 512 | 250 | 91 | 818 | 399 |
| 24 | 216 | 105 | 58 | 521 | 254 | 92 | 827 | 403 |
| 25 | 225 | 109 | 59 | 530 | 258 | 93 | 836 | 407 |
| 26 | 234 | 114 | 60 | 539 | 263 | 94 | 845 | 412 |
| 27 | 243 | 118 | 61 | 548 | 267 | 95 | 854 | 416 |
| 28 | 252 | 123 | 62 | 557 | 272 | 96 | 863 | 421 |
| 29 | 261 | 127 | 63 | 566 | 276 | 97 | 872 | 425 |
| 30 | 270 | 131 | 64 | 575 | 280 | 98 | 881 | 429 |
| 31 | 279 | 136 | 65 | 584 | 285 | 99 | 890 | 434 |
| 32 | 288 | 140 | 66 | 593 | 289 | 100 | 899 | 438 |
| 33 | 297 | 144 | 67 | 602 | 294 | 200 | 1798 | 877 |
| 34 | 306 | 149 | 68 | 611 | 298 | 300 | 2696 | 1315 |

| M | 27d | 63d | M | 27d | 63d | Min. | 27d. | 63d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 9 | 5 | 35 | 312 | 159 | 69 | 615 | 313 |
| 2 | 18 | 9 | 36 | 321 | 163 | 70 | 624 | 318 |
| 3 | 27 | 14 | 37 | 330 | 168 | 71 | 633 | 322 |
| 4 | 36 | 18 | 38 | 338 | 172 | 72 | 641 | 327 |
| 5 | 45 | 23 | 39 | 347 | 177 | 73 | 650 | 332 |
| 6 | 53 | 27 | 40 | 356 | 182 | 74 | 659 | 336 |
| 7 | 62 | 32 | 41 | 365 | 186 | 75 | 668 | 341 |
| 8 | 71 | 36 | 42 | 374 | 191 | 76 | 677 | 345 |
| 9 | 80 | 41 | 43 | 383 | 195 | 77 | 686 | 350 |
| 10 | 89 | 45 | 44 | 391 | 200 | 78 | 695 | 354 |
| 11 | 98 | 50 | 45 | 401 | 204 | 79 | 704 | 359 |
| 12 | 107 | 54 | 46 | 410 | 209 | 80 | 713 | 363 |
| 13 | 116 | 59 | 47 | 419 | 213 | 81 | 722 | 368 |
| 14 | 125 | 63 | 48 | 428 | 218 | 82 | 731 | 372 |
| 15 | 134 | 68 | 49 | 436 | 222 | 83 | 739 | 377 |
| 16 | 143 | 72 | 50 | 445 | 227 | 84 | 748 | 381 |
| 17 | 151 | 77 | 51 | 454 | 232 | 85 | 757 | 386 |
| 18 | 160 | 82 | 52 | 463 | 236 | 86 | 766 | 390 |
| 19 | 169 | 86 | 53 | 472 | 241 | 87 | 775 | 395 |
| 20 | 178 | 91 | 54 | 481 | 245 | 88 | 784 | 400 |
| 21 | 187 | 95 | 55 | 490 | 250 | 89 | 793 | 404 |
| 22 | 196 | 100 | 56 | 499 | 254 | 90 | 802 | 409 |
| 23 | 205 | 104 | 57 | 508 | 259 | 91 | 811 | 413 |
| 24 | 214 | 109 | 58 | 517 | 263 | 92 | 820 | 418 |
| 25 | 223 | 113 | 59 | 526 | 268 | 93 | 829 | 422 |
| 26 | 232 | 118 | 60 | 535 | 272 | 94 | 837 | 427 |
| 27 | 241 | 122 | 61 | 543 | 277 | 95 | 846 | 431 |
| 28 | 249 | 127 | 62 | 552 | 282 | 96 | 855 | 436 |
| 29 | 258 | 132 | 63 | 561 | 286 | 97 | 864 | 440 |
| 30 | 267 | 136 | 64 | 570 | 291 | 98 | 873 | 445 |
| 31 | 276 | 141 | 65 | 579 | 295 | 99 | 882 | 449 |
| 32 | 285 | 145 | 66 | 588 | 300 | 100 | 891 | 454 |
| 33 | 294 | 150 | 67 | 597 | 304 | 200 | 1782 | 909 |
| 34 | 303 | 154 | 68 | 606 | 309 | 300 | 2673 | 1363 |

| M | 28d | 62 d. | M | 28d | 62d | Min. | 28d. | 62 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 9 | 5 | 35 | 309 | 164 | 69 | 609 | 324 |
| 2 | 18 | 9 | 36 | 318 | 169 | 70 | 618 | 329 |
| 3 | 26 | 14 | 37 | 326 | 174 | 71 | 627 | 333 |
| 4 | 35 | 19 | 38 | 335 | 178 | 72 | 636 | 338 |
| 5 | 44 | 23 | 39 | 344 | 183 | 73 | 644 | 342 |
| 6 | 53 | 28 | 40 | 353 | 188 | 74 | 653 | 347 |
| 7 | 62 | 33 | 41 | 362 | 192 | 75 | 662 | 352 |
| 8 | 71 | 37 | 42 | 371 | 197 | 76 | 671 | 357 |
| 9 | 79 | 42 | 43 | 380 | 202 | 77 | 680 | 361 |
| 10 | 88 | 47 | 44 | 388 | 207 | 78 | 689 | 366 |
| 11 | 97 | 52 | 45 | 397 | 211 | 79 | 697 | 371 |
| 12 | 106 | 56 | 46 | 406 | 216 | 80 | 706 | 376 |
| 13 | 115 | 61 | 47 | 415 | 221 | 81 | 715 | 380 |
| 14 | 124 | 66 | 48 | 424 | 225 | 82 | 724 | 385 |
| 15 | 132 | 70 | 49 | 432 | 230 | 83 | 733 | 390 |
| 16 | 141 | 75 | 50 | 441 | 235 | 84 | 742 | 394 |
| 17 | 150 | 80 | 51 | 450 | 239 | 85 | 750 | 399 |
| 18 | 159 | 84 | 52 | 459 | 244 | 86 | 759 | 404 |
| 19 | 168 | 89 | 53 | 468 | 249 | 87 | 768 | 408 |
| 20 | 177 | 94 | 54 | 477 | 254 | 88 | 777 | 413 |
| 21 | 185 | 99 | 55 | 485 | 258 | 89 | 786 | 418 |
| 22 | 194 | 103 | 56 | 494 | 263 | 90 | 795 | 422 |
| 23 | 203 | 108 | 57 | 503 | 268 | 91 | 803 | 427 |
| 24 | 212 | 113 | 58 | 512 | 272 | 92 | 812 | 432 |
| 25 | 221 | 117 | 59 | 521 | 277 | 93 | 821 | 437 |
| 26 | 230 | 122 | 60 | 530 | 282 | 94 | 830 | 441 |
| 27 | 238 | 127 | 61 | 538 | 286 | 95 | 839 | 446 |
| 28 | 247 | 131 | 62 | 547 | 291 | 96 | 848 | 451 |
| 29 | 256 | 136 | 63 | 556 | 296 | 97 | 856 | 455 |
| 30 | 265 | 141 | 64 | 565 | 300 | 98 | 865 | 460 |
| 31 | 274 | 145 | 65 | 574 | 305 | 99 | 874 | 465 |
| 32 | 282 | 150 | 66 | 583 | 310 | 100 | 883 | 469 |
| 33 | 291 | 155 | 67 | 591 | 315 | 200 | 1766 | 939 |
| 34 | 300 | 160 | 68 | 600 | 319 | 300 | 2649 | 1408 |

| M | 29d | 61 d. | M | 29d | 61d | Min. | 29 d. | 61 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 9 | 5 | 35 | 306 | 170 | 69 | 604 | 334 |
| 2 | 17 | 10 | 36 | 315 | 174 | 70 | 612 | 339 |
| 3 | 26 | 14 | 37 | 324 | 179 | 71 | 621 | 344 |
| 4 | 35 | 19 | 38 | 332 | 184 | 72 | 630 | 349 |
| 5 | 44 | 24 | 39 | 341 | 189 | 73 | 638 | 354 |
| 6 | 52 | 29 | 40 | 350 | 194 | 74 | 647 | 359 |
| 7 | 61 | 34 | 41 | 359 | 199 | 75 | 656 | 363 |
| 8 | 70 | 39 | 42 | 367 | 203 | 76 | 665 | 368 |
| 9 | 79 | 43 | 43 | 376 | 208 | 77 | 673 | 373 |
| 10 | 87 | 48 | 44 | 385 | 213 | 78 | 682 | 378 |
| 11 | 96 | 53 | 45 | 394 | 218 | 79 | 691 | 383 |
| 12 | 105 | 58 | 46 | 402 | 223 | 80 | 700 | 388 |
| 13 | 114 | 63 | 47 | 411 | 228 | 81 | 708 | 393 |
| 14 | 122 | 68 | 48 | 420 | 233 | 82 | 717 | 397 |
| 15 | 131 | 73 | 49 | 429 | 237 | 83 | 726 | 402 |
| 16 | 140 | 77 | 50 | 437 | 242 | 84 | 735 | 407 |
| 17 | 149 | 82 | 51 | 446 | 247 | 85 | 743 | 412 |
| 18 | 157 | 87 | 52 | 455 | 252 | 86 | 752 | 417 |
| 19 | 166 | 92 | 53 | 464 | 257 | 87 | 761 | 422 |
| 20 | 175 | 97 | 54 | 472 | 262 | 88 | 770 | 427 |
| 21 | 184 | 102 | 55 | 481 | 267 | 89 | 778 | 431 |
| 22 | 192 | 107 | 56 | 490 | 271 | 90 | 787 | 436 |
| 23 | 201 | 111 | 57 | 499 | 276 | 91 | 796 | 441 |
| 24 | 210 | 116 | 58 | 507 | 281 | 92 | 805 | 446 |
| 25 | 219 | 121 | 59 | 516 | 286 | 93 | 813 | 451 |
| 26 | 227 | 126 | 60 | 525 | 291 | 94 | 822 | 456 |
| 27 | 236 | 131 | 61 | 534 | 296 | 95 | 831 | 461 |
| 28 | 245 | 136 | 62 | 542 | 301 | 96 | 840 | 465 |
| 29 | 254 | 141 | 63 | 551 | 305 | 97 | 848 | 470 |
| 30 | 262 | 145 | 64 | 560 | 310 | 98 | 857 | 475 |
| 31 | 271 | 150 | 65 | 569 | 315 | 99 | 866 | 480 |
| 32 | 280 | 155 | 66 | 577 | 320 | 100 | 875 | 485 |
| 33 | 289 | 160 | 67 | 586 | 325 | 200 | 1749 | 970 |
| 34 | 297 | 165 | 68 | 595 | 330 | 300 | 2624 | 1454 |

| M | 30d | 60 d. |
|---|---|---|
| 1 | 9 | 5 |
| 2 | 17 | 10 |
| 3 | 26 | 15 |
| 4 | 35 | 20 |
| 5 | 43 | 25 |
| 6 | 52 | 30 |
| 7 | 61 | 35 |
| 8 | 69 | 40 |
| 9 | 77 | 45 |
| 10 | 87 | 50 |
| 11 | 95 | 55 |
| 12 | 104 | 60 |
| 13 | 113 | 65 |
| 14 | 121 | 70 |
| 15 | 130 | 75 |
| 16 | 139 | 80 |
| 17 | 147 | 85 |
| 18 | 156 | 90 |
| 19 | 165 | 95 |
| 20 | 173 | 100 |
| 21 | 182 | 105 |
| 22 | 191 | 110 |
| 23 | 199 | 115 |
| 24 | 208 | 120 |
| 25 | 217 | 125 |
| 26 | 225 | 130 |
| 27 | 234 | 135 |
| 28 | 242 | 140 |
| 29 | 251 | 145 |
| 30 | 260 | 150 |
| 31 | 268 | 155 |
| 32 | 277 | 160 |
| 33 | 286 | 165 |
| 34 | 294 | 170 |
| 35 | 303 | 175 |
| 36 | 312 | 180 |
| 37 | 320 | 185 |
| 38 | 329 | 190 |
| 39 | 338 | 195 |
| 40 | 346 | 200 |
| 41 | 355 | 205 |
| 42 | 364 | 210 |
| 43 | 372 | 215 |
| 44 | 381 | 220 |
| 45 | 390 | 225 |
| 46 | 398 | 230 |
| 47 | 407 | 235 |
| 48 | 416 | 240 |
| 49 | 424 | 245 |
| 50 | 433 | 250 |
| 51 | 442 | 255 |
| 52 | 450 | 260 |
| 53 | 459 | 265 |
| 54 | 468 | 270 |
| 55 | 476 | 275 |
| 56 | 485 | 280 |
| 57 | 494 | 285 |
| 58 | 502 | 290 |
| 59 | 511 | 295 |
| 60 | 520 | 300 |
| 61 | 528 | 305 |
| 62 | 537 | 310 |
| 63 | 546 | 315 |
| 64 | 554 | 320 |
| 65 | 563 | 325 |
| 66 | 572 | 330 |
| 67 | 580 | 335 |
| 68 | 589 | 340 |

| Min. | 30 d. | 60 d. |
|---|---|---|
| 69 | 598 | 345 |
| 70 | 606 | 350 |
| 71 | 615 | 355 |
| 72 | 623 | 360 |
| 73 | 632 | 365 |
| 74 | 641 | 370 |
| 75 | 649 | 375 |
| 76 | 658 | 380 |
| 77 | 667 | 385 |
| 78 | 676 | 390 |
| 79 | 684 | 395 |
| 80 | 693 | 400 |
| 81 | 702 | 405 |
| 82 | 710 | 410 |
| 83 | 719 | 415 |
| 84 | 727 | 420 |
| 85 | 736 | 425 |
| 86 | 745 | 430 |
| 87 | 753 | 435 |
| 88 | 762 | 440 |
| 89 | 771 | 445 |
| 90 | 779 | 450 |
| 91 | 788 | 455 |
| 92 | 797 | 460 |
| 93 | 806 | 465 |
| 94 | 814 | 470 |
| 95 | 823 | 475 |
| 96 | 832 | 480 |
| 97 | 840 | 485 |
| 98 | 849 | 490 |
| 99 | 857 | 495 |
| 100 | 866 | 500 |
| 200 | 1732 | 1000 |
| 300 | 2598 | 1500 |

| M | 31d | 59 d. |
|---|---|---|
| 1 | 9 | 5 |
| 2 | 17 | 10 |
| 3 | 26 | 15 |
| 4 | 34 | 21 |
| 5 | 43 | 26 |
| 6 | 51 | 31 |
| 7 | 60 | 36 |
| 8 | 69 | 41 |
| 9 | 77 | 46 |
| 10 | 86 | 51 |
| 11 | 94 | 57 |
| 12 | 103 | 62 |
| 13 | 111 | 67 |
| 14 | 120 | 72 |
| 15 | 129 | 77 |
| 16 | 137 | 82 |
| 17 | 146 | 88 |
| 18 | 154 | 93 |
| 19 | 163 | 98 |
| 20 | 171 | 103 |
| 21 | 180 | 108 |
| 22 | 189 | 113 |
| 23 | 197 | 118 |
| 24 | 206 | 124 |
| 25 | 214 | 129 |
| 26 | 223 | 134 |
| 27 | 231 | 139 |
| 28 | 240 | 144 |
| 29 | 249 | 149 |
| 30 | 257 | 154 |
| 31 | 266 | 160 |
| 32 | 274 | 165 |
| 33 | 283 | 170 |
| 34 | 292 | 175 |

| M | 31d | 59d |
|---|---|---|
| 35 | 300 | 180 |
| 36 | 309 | 185 |
| 37 | 317 | 191 |
| 38 | 326 | 196 |
| 39 | 334 | 201 |
| 40 | 343 | 206 |
| 41 | 351 | 211 |
| 42 | 360 | 216 |
| 43 | 369 | 221 |
| 44 | 377 | 227 |
| 45 | 386 | 232 |
| 46 | 394 | 237 |
| 47 | 403 | 242 |
| 48 | 411 | 247 |
| 49 | 420 | 252 |
| 50 | 429 | 257 |
| 51 | 437 | 263 |
| 52 | 446 | 268 |
| 53 | 454 | 273 |
| 54 | 463 | 278 |
| 55 | 471 | 283 |
| 56 | 480 | 288 |
| 57 | 489 | 294 |
| 58 | 497 | 299 |
| 59 | 506 | 304 |
| 60 | 514 | 309 |
| 61 | 523 | 314 |
| 62 | 531 | 319 |
| 63 | 540 | 324 |
| 64 | 549 | 330 |
| 65 | 557 | 335 |
| 66 | 566 | 340 |
| 67 | 574 | 345 |
| 68 | 583 | 350 |

| Min. | 31 d. | 59 d. |
|---|---|---|
| 69 | 591 | 355 |
| 70 | 600 | 360 |
| 71 | 609 | 366 |
| 72 | 617 | 371 |
| 73 | 626 | 376 |
| 74 | 634 | 381 |
| 75 | 643 | 386 |
| 76 | 651 | 391 |
| 77 | 660 | 397 |
| 78 | 669 | 402 |
| 79 | 677 | 407 |
| 80 | 686 | 412 |
| 81 | 694 | 417 |
| 82 | 703 | 422 |
| 83 | 711 | 427 |
| 84 | 720 | 433 |
| 85 | 729 | 438 |
| 86 | 737 | 443 |
| 87 | 746 | 448 |
| 88 | 754 | 453 |
| 89 | 763 | 458 |
| 90 | 771 | 463 |
| 91 | 780 | 469 |
| 92 | 789 | 474 |
| 93 | 797 | 479 |
| 94 | 806 | 484 |
| 95 | 814 | 489 |
| 96 | 823 | 494 |
| 97 | 831 | 500 |
| 98 | 840 | 505 |
| 99 | 849 | 510 |
| 100 | 857 | 515 |
| 200 | 1714 | 1030 |
| 300 | 2572 | 1545 |

| M | 32d | 58 d |
|---|---|---|
| 1 | 8 | 5 |
| 2 | 17 | 11 |
| 3 | 25 | 16 |
| 4 | 34 | 21 |
| 5 | 42 | 26 |
| 6 | 51 | 32 |
| 7 | 59 | 37 |
| 8 | 68 | 42 |
| 9 | 76 | 48 |
| 10 | 85 | 53 |
| 11 | 93 | 58 |
| 12 | 102 | 64 |
| 13 | 110 | 69 |
| 14 | 119 | 74 |
| 15 | 127 | 79 |
| 16 | 136 | 85 |
| 17 | 144 | 90 |
| 18 | 153 | 95 |
| 19 | 161 | 101 |
| 20 | 170 | 106 |
| 21 | 178 | 111 |
| 22 | 187 | 117 |
| 23 | 195 | 122 |
| 24 | 204 | 127 |
| 25 | 212 | 132 |
| 26 | 220 | 138 |
| 27 | 229 | 143 |
| 28 | 237 | 148 |
| 29 | 246 | 153 |
| 30 | 254 | 159 |
| 31 | 263 | 164 |
| 32 | 271 | 170 |
| 33 | 280 | 175 |
| 34 | 288 | 180 |

| M | 32d | 58d |
|---|---|---|
| 35 | 297 | 185 |
| 36 | 305 | 191 |
| 37 | 314 | 196 |
| 38 | 322 | 201 |
| 39 | 331 | 207 |
| 40 | 339 | 212 |
| 41 | 348 | 217 |
| 42 | 356 | 223 |
| 43 | 365 | 228 |
| 44 | 373 | 238 |
| 45 | 382 | 240 |
| 46 | 390 | 244 |
| 47 | 398 | 249 |
| 48 | 407 | 254 |
| 49 | 415 | 260 |
| 50 | 424 | 265 |
| 51 | 432 | 270 |
| 52 | 441 | 275 |
| 53 | 449 | 281 |
| 54 | 458 | 286 |
| 55 | 466 | 291 |
| 56 | 475 | 297 |
| 57 | 483 | 302 |
| 58 | 492 | 307 |
| 59 | 500 | 313 |
| 60 | 509 | 318 |
| 61 | 517 | 323 |
| 62 | 526 | 329 |
| 63 | 534 | 334 |
| 64 | 543 | 339 |
| 65 | 55 | 344 |
| 66 | 560 | 350 |
| 67 | 568 | 355 |
| 68 | 577 | 360 |

| Min. | 32 d. | 58 d. |
|---|---|---|
| 69 | 585 | 366 |
| 70 | 594 | 371 |
| 71 | 602 | 376 |
| 72 | 610 | 381 |
| 73 | 619 | 387 |
| 74 | 627 | 392 |
| 75 | 636 | 397 |
| 76 | 644 | 403 |
| 77 | 653 | 408 |
| 78 | 661 | 413 |
| 79 | 670 | 419 |
| 80 | 678 | 424 |
| 81 | 687 | 429 |
| 82 | 695 | 434 |
| 83 | 703 | 440 |
| 84 | 712 | 445 |
| 85 | 721 | 450 |
| 86 | 729 | 456 |
| 87 | 738 | 461 |
| 88 | 746 | 466 |
| 89 | 755 | 472 |
| 90 | 763 | 477 |
| 91 | 772 | 482 |
| 92 | 780 | 487 |
| 93 | 788 | 493 |
| 94 | 797 | 498 |
| 95 | 805 | 503 |
| 96 | 814 | 509 |
| 97 | 822 | 514 |
| 98 | 831 | 519 |
| 99 | 839 | 524 |
| 100 | 848 | 530 |
| 200 | 1696 | 1060 |
| 300 | 2544 | 1590 |

| M | 33d | 57 d |
|---|---|---|
| 1 | 8 | 5 |
| 2 | 17 | 11 |
| 3 | 25 | 16 |
| 4 | 34 | 22 |
| 5 | 42 | 27 |
| 6 | 50 | 33 |
| 7 | 59 | 38 |
| 8 | 67 | 44 |
| 9 | 76 | 49 |
| 10 | 84 | 54 |
| 11 | 92 | 60 |
| 12 | 101 | 65 |
| 13 | 109 | 71 |
| 14 | 117 | 76 |
| 15 | 126 | 82 |
| 16 | 134 | 87 |
| 17 | 143 | 93 |
| 18 | 151 | 98 |
| 19 | 159 | 104 |
| 20 | 168 | 109 |
| 21 | 176 | 114 |
| 22 | 185 | 120 |
| 23 | 193 | 125 |
| 24 | 201 | 131 |
| 25 | 210 | 136 |
| 26 | 218 | 142 |
| 27 | 227 | 147 |
| 28 | 235 | 153 |
| 29 | 243 | 158 |
| 30 | 252 | 163 |
| 31 | 260 | 169 |
| 32 | 269 | 174 |
| 33 | 277 | 180 |
| 34 | 285 | 185 |

| M | 33d | 57d |
|---|---|---|
| 35 | 294 | 191 |
| 36 | 302 | 196 |
| 37 | 311 | 202 |
| 38 | 319 | 207 |
| 39 | 327 | 212 |
| 40 | 335 | 218 |
| 41 | 344 | 223 |
| 42 | 352 | 229 |
| 43 | 361 | 234 |
| 44 | 369 | 240 |
| 45 | 377 | 245 |
| 46 | 386 | 251 |
| 47 | 394 | 256 |
| 48 | 403 | 262 |
| 49 | 411 | 267 |
| 50 | 419 | 272 |
| 51 | 428 | 278 |
| 52 | 436 | 283 |
| 53 | 445 | 288 |
| 54 | 453 | 294 |
| 55 | 461 | 300 |
| 56 | 470 | 305 |
| 57 | 478 | 310 |
| 58 | 487 | 316 |
| 59 | 495 | 321 |
| 60 | 503 | 327 |
| 61 | 512 | 332 |
| 62 | 520 | 338 |
| 63 | 529 | 343 |
| 64 | 537 | 348 |
| 65 | 545 | 354 |
| 66 | 554 | 359 |
| 67 | 562 | 365 |
| 68 | 571 | 370 |

| Min. | 33 d. | 57 d. |
|---|---|---|
| 69 | 579 | 376 |
| 70 | 587 | 381 |
| 71 | 596 | 386 |
| 72 | 604 | 392 |
| 73 | 612 | 397 |
| 74 | 621 | 403 |
| 75 | 629 | 408 |
| 76 | 637 | 414 |
| 77 | 646 | 419 |
| 78 | 654 | 425 |
| 79 | 663 | 430 |
| 80 | 671 | 436 |
| 81 | 679 | 441 |
| 82 | 688 | 446 |
| 83 | 696 | 452 |
| 84 | 705 | 457 |
| 85 | 713 | 462 |
| 86 | 721 | 468 |
| 87 | 730 | 473 |
| 88 | 738 | 479 |
| 89 | 747 | 484 |
| 90 | 755 | 490 |
| 91 | 763 | 495 |
| 92 | 772 | 501 |
| 93 | 780 | 506 |
| 94 | 789 | 512 |
| 95 | 797 | 517 |
| 96 | 805 | 522 |
| 97 | 814 | 528 |
| 98 | 822 | 533 |
| 99 | 831 | 539 |
| 100 | 839 | 545 |
| 200 | 1677 | 1089 |
| 300 | 2516 | 1634 |

| M | 34d | 56d | M | 34d | 56d | Min. | 34 d. | 56 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 8 | 6 | 35 | 290 | 196 | 69 | 572 | 386 |
| 2 | 17 | 11 | 36 | 298 | 201 | 70 | 580 | 391 |
| 3 | 25 | 17 | 37 | 307 | 207 | 71 | 588 | 397 |
| 4 | 33 | 22 | 38 | 315 | 212 | 72 | 597 | 403 |
| 5 | 41 | 28 | 39 | 323 | 218 | 73 | 605 | 408 |
| 6 | 50 | 34 | 40 | 332 | 224 | 74 | 613 | 414 |
| 7 | 58 | 39 | 41 | 340 | 229 | 75 | 622 | 419 |
| 8 | 66 | 45 | 42 | 348 | 235 | 76 | 630 | 425 |
| 9 | 75 | 50 | 43 | 356 | 240 | 77 | 638 | 431 |
| 10 | 83 | 56 | 44 | 365 | 246 | 78 | 647 | 436 |
| 11 | 91 | 61 | 45 | 373 | 251 | 79 | 655 | 442 |
| 12 | 99 | 67 | 46 | 381 | 257 | 80 | 663 | 447 |
| 13 | 108 | 73 | 47 | 390 | 263 | 81 | 671 | 453 |
| 14 | 116 | 78 | 48 | 398 | 268 | 82 | 680 | 458 |
| 15 | 124 | 84 | 49 | 406 | 274 | 83 | 688 | 464 |
| 16 | 133 | 89 | 50 | 414 | 280 | 84 | 696 | 470 |
| 17 | 141 | 95 | 51 | 423 | 285 | 85 | 705 | 475 |
| 18 | 149 | 101 | 52 | 431 | 291 | 86 | 713 | 481 |
| 19 | 158 | 106 | 53 | 439 | 296 | 87 | 721 | 486 |
| 20 | 166 | 112 | 54 | 448 | 302 | 88 | 729 | 492 |
| 21 | 174 | 117 | 55 | 456 | 307 | 89 | 738 | 498 |
| 22 | 182 | 123 | 56 | 464 | 313 | 90 | 746 | 503 |
| 23 | 191 | 129 | 57 | 473 | 319 | 91 | 754 | 509 |
| 24 | 199 | 134 | 58 | 481 | 324 | 92 | 763 | 514 |
| 25 | 207 | 140 | 59 | 489 | 330 | 93 | 771 | 520 |
| 26 | 216 | 145 | 60 | 497 | 335 | 94 | 779 | 526 |
| 27 | 224 | 151 | 61 | 506 | 341 | 95 | 788 | 531 |
| 28 | 232 | 157 | 62 | 514 | 347 | 96 | 796 | 537 |
| 29 | 240 | 162 | 63 | 522 | 352 | 97 | 804 | 542 |
| 30 | 249 | 168 | 64 | 530 | 358 | 98 | 812 | 548 |
| 31 | 257 | 173 | 65 | 539 | 363 | 99 | 821 | 554 |
| 32 | 265 | 179 | 66 | 547 | 369 | 100 | 829 | 559 |
| 33 | 274 | 184 | 67 | 555 | 374 | 200 | 1658 | 1118 |
| 34 | 282 | 190 | 68 | 564 | 380 | 300 | 2487 | 1678 |

| M | 35d | 55d | M | 35d | 55d | Min. | 35 d. | 55 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 8 | 6 | 35 | 286 | 201 | 69 | 565 | 396 |
| 2 | 17 | 11 | 36 | 295 | 206 | 70 | 573 | 402 |
| 3 | 25 | 17 | 37 | 303 | 212 | 71 | 582 | 407 |
| 4 | 33 | 23 | 38 | 311 | 218 | 72 | 590 | 413 |
| 5 | 41 | 29 | 39 | 319 | 224 | 73 | 598 | 419 |
| 6 | 49 | 34 | 40 | 328 | 229 | 74 | 606 | 425 |
| 7 | 57 | 40 | 41 | 336 | 235 | 75 | 615 | 430 |
| 8 | 66 | 46 | 42 | 344 | 241 | 76 | 623 | 436 |
| 9 | 74 | 52 | 43 | 352 | 246 | 77 | 631 | 442 |
| 10 | 82 | 57 | 44 | 360 | 252 | 78 | 639 | 448 |
| 11 | 90 | 63 | 45 | 368 | 258 | 79 | 647 | 453 |
| 12 | 98 | 69 | 46 | 377 | 264 | 80 | 655 | 459 |
| 13 | 106 | 75 | 47 | 385 | 270 | 81 | 664 | 465 |
| 14 | 115 | 80 | 48 | 393 | 275 | 82 | 672 | 470 |
| 15 | 123 | 86 | 49 | 401 | 281 | 83 | 680 | 476 |
| 16 | 131 | 92 | 50 | 410 | 287 | 84 | 688 | 482 |
| 17 | 139 | 98 | 51 | 418 | 292 | 85 | 696 | 488 |
| 18 | 147 | 103 | 52 | 426 | 298 | 86 | 705 | 493 |
| 19 | 156 | 109 | 53 | 434 | 304 | 87 | 713 | 499 |
| 20 | 164 | 115 | 54 | 442 | 310 | 88 | 721 | 505 |
| 21 | 172 | 120 | 55 | 451 | 315 | 89 | 729 | 511 |
| 22 | 180 | 126 | 56 | 459 | 321 | 90 | 737 | 516 |
| 23 | 188 | 132 | 57 | 467 | 327 | 91 | 746 | 522 |
| 24 | 196 | 138 | 58 | 475 | 333 | 92 | 754 | 528 |
| 25 | 205 | 143 | 59 | 483 | 338 | 93 | 762 | 534 |
| 26 | 213 | 149 | 60 | 491 | 344 | 94 | 770 | 539 |
| 27 | 221 | 155 | 61 | 500 | 350 | 95 | 778 | 545 |
| 28 | 229 | 161 | 62 | [illegible] | 356 | 96 | 786 | 551 |
| 29 | 237 | 166 | 63 | 516 | 361 | 97 | 795 | 556 |
| 30 | 246 | 172 | 64 | 524 | 367 | 98 | 803 | 562 |
| 31 | 254 | 178 | 65 | 533 | 373 | 99 | 811 | 568 |
| 32 | 262 | 184 | 66 | 541 | 379 | 100 | 819 | 574 |
| 33 | 270 | 189 | 67 | 549 | 384 | 200 | 1638 | 1147 |
| 34 | 278 | 195 | 68 | 557 | 390 | 300 | 2458 | 1721 |

| M | 36d | 54'd. |
|---|---|---|
| 1 | 8 | 6 |
| 2 | 16 | 12 |
| 3 | 24 | 18 |
| 4 | 32 | 23 |
| 5 | 40 | 29 |
| 6 | 48 | 35 |
| 7 | 57 | 41 |
| 8 | 65 | 47 |
| 9 | 72 | 53 |
| 10 | 81 | 59 |
| 11 | 89 | 65 |
| 12 | 97 | 70 |
| 13 | 105 | 76 |
| 14 | 113 | 82 |
| 15 | 121 | 88 |
| 16 | 129 | 94 |
| 17 | 138 | 100 |
| 18 | 146 | 106 |
| 19 | 154 | 112 |
| 20 | 162 | 118 |
| 21 | 170 | 123 |
| 22 | 178 | 129 |
| 23 | 186 | 135 |
| 24 | 194 | 141 |
| 25 | 202 | 147 |
| 26 | 210 | 153 |
| 27 | 218 | 159 |
| 28 | 226 | 164 |
| 29 | 235 | 170 |
| 30 | 243 | 176 |
| 31 | 251 | 182 |
| 32 | 259 | 188 |
| 33 | 267 | 194 |
| 34 | 275 | 200 |

| M | 36d | 54d |
|---|---|---|
| 35 | 283 | 166 |
| 36 | 291 | 211 |
| 37 | 299 | 217 |
| 38 | 307 | 223 |
| 39 | 315 | 229 |
| 40 | 324 | 235 |
| 41 | 332 | 241 |
| 42 | 340 | 247 |
| 43 | 348 | 253 |
| 44 | 356 | 258 |
| 45 | 364 | 264 |
| 46 | 372 | 270 |
| 47 | 380 | 276 |
| 48 | 388 | 282 |
| 49 | 396 | 288 |
| 50 | 404 | 294 |
| 51 | 413 | 300 |
| 52 | 421 | 306 |
| 53 | 429 | 311 |
| 54 | 437 | 317 |
| 55 | 445 | 323 |
| 56 | 453 | 329 |
| 57 | 461 | 335 |
| 58 | 469 | 341 |
| 59 | 477 | 347 |
| 60 | 485 | 353 |
| 61 | 493 | 358 |
| 62 | 502 | 364 |
| 63 | 510 | 370 |
| 64 | 518 | 376 |
| 65 | 526 | 382 |
| 66 | 534 | 388 |
| 67 | 542 | 394 |
| 68 | 550 | 400 |

| Min. | 36 d. | 54 d. |
|---|---|---|
| 69 | 558 | 406 |
| 70 | 566 | 411 |
| 71 | 574 | 417 |
| 72 | 582 | 423 |
| 73 | 590 | 429 |
| 74 | 599 | 435 |
| 75 | 607 | 441 |
| 76 | 615 | 447 |
| 77 | 623 | 453 |
| 78 | 631 | 458 |
| 79 | 639 | 464 |
| 80 | 647 | 470 |
| 81 | 655 | 476 |
| 82 | 663 | 488 |
| 83 | 671 | 492 |
| 84 | 680 | 494 |
| 85 | 688 | 500 |
| 86 | 696 | 506 |
| 87 | 704 | 511 |
| 88 | 712 | 517 |
| 89 | 720 | 523 |
| 90 | 728 | 529 |
| 91 | 736 | 535 |
| 92 | 744 | 541 |
| 93 | 752 | 547 |
| 94 | 760 | 553 |
| 95 | 768 | 558 |
| 96 | 777 | 564 |
| 97 | 785 | 570 |
| 98 | 793 | 576 |
| 99 | 801 | 582 |
| 100 | 809 | 588 |
| 200 | 1618 | 1176 |
| 300 | 2427 | 1763 |

| M | 37 d | 53 d. | M | 37 d | 53 d | Min. | 37 d. | 53 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 8 | 6 | 35 | 279 | 210 | 69 | 551 | 415 |
| 2 | 16 | 12 | 36 | 287 | 216 | 70 | 559 | 421 |
| 3 | 24 | 18 | 37 | 295 | 222 | 71 | 567 | 427 |
| 4 | 32 | 24 | 38 | 303 | 228 | 72 | 575 | 433 |
| 5 | 40 | 30 | 39 | 311 | 234 | 73 | 583 | 439 |
| 6 | 48 | 36 | 40 | 319 | 241 | 74 | 591 | 445 |
| 7 | 56 | 42 | 41 | 327 | 247 | 75 | 599 | 451 |
| 8 | 64 | 48 | 42 | 335 | 253 | 76 | 607 | 457 |
| 9 | 72 | 54 | 43 | 343 | 259 | 77 | 615 | 463 |
| 10 | 80 | 60 | 44 | 351 | 265 | 78 | 623 | 469 |
| 11 | 88 | 66 | 45 | 359 | 271 | 79 | 631 | 475 |
| 12 | 96 | 72 | 46 | 367 | 277 | 80 | 639 | 481 |
| 13 | 104 | 78 | 47 | 375 | 283 | 81 | 647 | 487 |
| 14 | 112 | 84 | 48 | 383 | 289 | 82 | 655 | 493 |
| 15 | 120 | 90 | 49 | 391 | 295 | 83 | 663 | 500 |
| 16 | 128 | 96 | 50 | 399 | 301 | 84 | 671 | 506 |
| 17 | 136 | 102 | 51 | 407 | 307 | 85 | 679 | 512 |
| 18 | 144 | 108 | 52 | 415 | 313 | 86 | 687 | 518 |
| 19 | 152 | 114 | 53 | 423 | 319 | 87 | 695 | 524 |
| 20 | 160 | 120 | 54 | 431 | 325 | 88 | 703 | 530 |
| 21 | 168 | 126 | 55 | 439 | 331 | 89 | 711 | 536 |
| 22 | 176 | 132 | 56 | 447 | 337 | 90 | 719 | 542 |
| 23 | 184 | 138 | 57 | 455 | 343 | 91 | 727 | 548 |
| 24 | 192 | 144 | 58 | 463 | 349 | 92 | 735 | 554 |
| 25 | 200 | 150 | 59 | 471 | 355 | 93 | 743 | 560 |
| 26 | 208 | 156 | 60 | 479 | 361 | 94 | 751 | 566 |
| 27 | 216 | 162 | 61 | 487 | 367 | 95 | 759 | 572 |
| 28 | 224 | 168 | 62 | 495 | 373 | 96 | 767 | 578 |
| 29 | 232 | 174 | 63 | 503 | 379 | 97 | 775 | 584 |
| 30 | 240 | 180 | 64 | 511 | 385 | 98 | 783 | 590 |
| 31 | 248 | 186 | 65 | 519 | 391 | 99 | 791 | 596 |
| 32 | 256 | 192 | 66 | 527 | 397 | 100 | 799 | 602 |
| 33 | 264 | 198 | 67 | 535 | 403 | 200 | 1597 | 1204 |
| 34 | 271 | 204 | 68 | 543 | 409 | 300 | 2396 | 1805 |

| M | 38 d. | 52 d. | M | 38 d. | 52 d. | Min. | 38 d. | 52 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 8 | 6 | 35 | 276 | 216 | 69 | 544 | 425 |
| 2 | 16 | 12 | 36 | 284 | 222 | 70 | 552 | 431 |
| 3 | 24 | 18 | 37 | 292 | 228 | 71 | 559 | 437 |
| 4 | 31 | 25 | 38 | 299 | 234 | 72 | 567 | 443 |
| 5 | 39 | 31 | 39 | 307 | 240 | 73 | 575 | 450 |
| 6 | 47 | 37 | 40 | 315 | 246 | 74 | 583 | 456 |
| 7 | 55 | 43 | 41 | 323 | 252 | 75 | 591 | 462 |
| 8 | 63 | 49 | 42 | 331 | 259 | 76 | 599 | 468 |
| 9 | 71 | 55 | 43 | 339 | 265 | 77 | 607 | 474 |
| 10 | 79 | 62 | 44 | 347 | 271 | 78 | 615 | 480 |
| 11 | 87 | 68 | 45 | 355 | 277 | 79 | 622 | 486 |
| 12 | 95 | 74 | 46 | 362 | 283 | 80 | 630 | 493 |
| 13 | 102 | 80 | 47 | 370 | 289 | 81 | 638 | 499 |
| 14 | 110 | 86 | 48 | 378 | 296 | 82 | 646 | 505 |
| 15 | 118 | 92 | 49 | 386 | 302 | 83 | 654 | 511 |
| 16 | 126 | 99 | 50 | 394 | 308 | 84 | 662 | 517 |
| 17 | 134 | 105 | 51 | 402 | 314 | 85 | 670 | 523 |
| 18 | 142 | 111 | 52 | 410 | 320 | 86 | 678 | 530 |
| 19 | 150 | 117 | 53 | 418 | 326 | 87 | 686 | 536 |
| 20 | 158 | 123 | 54 | 426 | 332 | 88 | 693 | 542 |
| 21 | 166 | 129 | 55 | 433 | 339 | 89 | 701 | 548 |
| 22 | 173 | 136 | 56 | 441 | 345 | 90 | 709 | 554 |
| 23 | 181 | 142 | 57 | 449 | 351 | 91 | 717 | 560 |
| 24 | 189 | 148 | 58 | 457 | 357 | 92 | 725 | 566 |
| 25 | 197 | 154 | 59 | 465 | 363 | 93 | 733 | 573 |
| 26 | 205 | 160 | 60 | 473 | 369 | 94 | 741 | 579 |
| 27 | 213 | 166 | 61 | 481 | 376 | 95 | 749 | 585 |
| 28 | 221 | 172 | 62 | 489 | 382 | 96 | 756 | 591 |
| 29 | 229 | 179 | 63 | 496 | 388 | 97 | 764 | 597 |
| 30 | 236 | 185 | 64 | 504 | 394 | 98 | 772 | 603 |
| 31 | 244 | 191 | 65 | 512 | 400 | 99 | 780 | 610 |
| 32 | 252 | 197 | 66 | 520 | 406 | 100 | 788 | 616 |
| 33 | 260 | 202 | 67 | 528 | 412 | 200 | 1576 | 1231 |
| 34 | 268 | 208 | 68 | 536 | 419 | 300 | 2364 | 1847 |

| M | 39d | 51d. | M | 39d | 51d | Min. | 39 d. | 51 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 8 | 6 | 35 | 272 | 220 | 69 | 536 | 434 |
| 2 | 16 | 13 | 36 | 280 | 226 | 70 | 544 | 440 |
| 3 | 23 | 19 | 37 | 287 | 233 | 71 | 552 | 447 |
| 4 | 31 | 25 | 38 | 295 | 239 | 72 | 559 | 453 |
| 5 | 39 | 31 | 39 | 303 | 245 | 73 | 567 | 459 |
| 6 | 47 | 38 | 40 | 311 | 252 | 74 | 575 | 466 |
| 7 | 54 | 44 | 41 | 318 | 258 | 75 | 583 | 472 |
| 8 | 62 | 50 | 42 | 326 | 264 | 76 | 591 | 478 |
| 9 | 70 | 57 | 43 | 334 | 271 | 77 | 598 | 485 |
| 10 | 78 | 63 | 44 | 342 | 277 | 78 | 606 | 491 |
| 11 | 85 | 69 | 45 | 350 | 283 | 79 | 614 | 497 |
| 12 | 93 | 75 | 46 | 357 | 289 | 80 | 622 | 503 |
| 13 | 101 | 82 | 47 | 365 | 296 | 81 | 629 | 510 |
| 14 | 109 | 88 | 48 | 373 | 302 | 82 | 637 | 516 |
| 15 | 116 | 94 | 49 | 381 | 308 | 83 | 645 | 522 |
| 16 | 124 | 101 | 50 | 388 | 315 | 84 | 653 | 529 |
| 17 | 132 | 107 | 51 | 396 | 321 | 85 | 661 | 535 |
| 18 | 140 | 113 | 52 | 404 | 327 | 86 | 668 | 541 |
| 19 | 148 | 119 | 53 | 412 | 334 | 87 | 676 | 547 |
| 20 | 155 | 126 | 54 | 419 | 340 | 88 | 684 | 554 |
| 21 | 163 | 132 | 55 | 427 | 346 | 89 | 692 | 560 |
| 22 | 171 | 138 | 56 | 435 | 352 | 90 | 699 | 566 |
| 23 | 179 | 145 | 57 | 443 | 359 | 91 | 707 | 573 |
| 24 | 186 | 151 | 58 | 451 | 365 | 92 | 715 | 579 |
| 25 | 194 | 157 | 59 | 458 | 371 | 93 | 723 | 585 |
| 26 | 202 | 164 | 60 | 466 | 378 | 94 | 731 | 591 |
| 27 | 210 | 170 | 61 | 474 | 384 | 95 | 738 | 598 |
| 28 | 217 | 176 | 62 | 482 | 390 | 96 | 746 | 604 |
| 29 | 225 | 182 | 63 | 489 | 396 | 97 | 754 | 610 |
| 30 | 232 | 189 | 64 | 497 | 403 | 98 | 762 | 617 |
| 31 | 241 | 195 | 65 | 505 | 409 | 99 | 769 | 623 |
| 32 | 249 | 201 | 66 | 513 | 415 | 100 | 777 | 629 |
| 33 | 256 | 208 | 67 | 521 | 422 | 200 | 1554 | 1259 |
| 34 | 264 | 214 | 68 | 528 | 428 | 300 | 2331 | 1888 |

| M | 40d | 50d. | M | 40d | 50d | Min. | 40d. | 50d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 8 | 6 | 35 | 268 | 225 | 69 | 529 | 443 |
| 2 | 15 | 13 | 36 | 276 | 231 | 70 | 536 | 450 |
| 3 | 23 | 19 | 37 | 283 | 238 | 71 | 544 | 456 |
| 4 | 31 | 26 | 38 | 291 | 244 | 72 | 552 | 463 |
| 5 | 38 | 32 | 39 | 299 | 251 | 73 | 559 | 469 |
| 6 | 46 | 38 | 40 | 306 | 257 | 74 | 567 | 476 |
| 7 | 54 | 45 | 41 | 314 | 263 | 75 | 574 | 482 |
| 8 | 61 | 51 | 42 | 322 | 270 | 76 | 582 | 489 |
| 9 | 69 | 58 | 43 | 329 | 276 | 77 | 590 | 495 |
| 10 | 77 | 64 | 44 | 337 | 283 | 78 | 597 | 501 |
| 11 | 84 | 71 | 45 | 345 | 289 | 79 | 605 | 508 |
| 12 | 92 | 77 | 46 | 352 | 296 | 80 | 613 | 514 |
| 13 | 100 | 83 | 47 | 360 | 302 | 81 | 620 | 521 |
| 14 | 107 | 90 | 48 | 368 | 309 | 82 | 628 | 527 |
| 15 | 115 | 96 | 49 | 375 | 315 | 83 | 636 | 533 |
| 16 | 123 | 103 | 50 | 383 | 321 | 84 | 643 | 540 |
| 17 | 130 | 109 | 51 | 391 | 328 | 85 | 651 | 546 |
| 18 | 138 | 116 | 52 | 398 | 334 | 86 | 659 | 553 |
| 19 | 146 | 122 | 53 | 406 | 341 | 87 | 666 | 559 |
| 20 | 153 | 129 | 54 | 414 | 347 | 88 | 674 | 566 |
| 21 | 161 | 135 | 55 | 421 | 353 | 89 | 682 | 572 |
| 22 | 169 | 141 | 56 | 429 | 360 | 90 | 689 | 579 |
| 23 | 176 | 148 | 57 | 437 | 366 | 91 | 697 | 585 |
| 24 | 184 | 154 | 58 | 444 | 373 | 92 | 705 | 591 |
| 25 | 192 | 161 | 59 | 452 | 379 | 93 | 712 | 598 |
| 26 | 199 | 167 | 60 | 460 | 386 | 94 | 720 | 604 |
| 27 | 207 | 173 | 61 | 467 | 392 | 95 | 727 | 611 |
| 28 | 214 | 180 | 62 | 475 | 399 | 96 | 735 | 617 |
| 29 | 222 | 186 | 63 | 483 | 405 | 97 | 743 | 623 |
| 30 | 230 | 193 | 64 | 490 | 411 | 98 | 751 | 630 |
| 31 | 237 | 199 | 65 | 498 | 418 | 99 | 758 | 636 |
| 32 | 245 | 206 | 66 | 506 | 424 | 100 | 766 | 643 |
| 33 | 253 | 212 | 67 | 513 | 431 | 200 | 1532 | 1286 |
| 34 | 260 | 219 | 68 | 521 | 437 | 300 | 2298 | 1928 |

| M | 39d | 51d. | M | 39d | 51d | Min. | 39 d. | 51 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 8 | 6 | 35 | 272 | 220 | 69 | 536 | 434 |
| 2 | 16 | 13 | 36 | 280 | 226 | 70 | 544 | 440 |
| 3 | 23 | 19 | 37 | 287 | 233 | 71 | 552 | 447 |
| 4 | 31 | 25 | 38 | 295 | 239 | 72 | 559 | 453 |
| 5 | 39 | 31 | 39 | 303 | 245 | 73 | 567 | 459 |
| 6 | 47 | 38 | 40 | 311 | 252 | 74 | 575 | 466 |
| 7 | 54 | 44 | 41 | 318 | 258 | 75 | 583 | 472 |
| 8 | 62 | 50 | 42 | 326 | 264 | 76 | 591 | 478 |
| 9 | 70 | 57 | 43 | 334 | 271 | 77 | 598 | 485 |
| 10 | 78 | 63 | 44 | 342 | 277 | 78 | 606 | 491 |
| 11 | 85 | 69 | 45 | 350 | 283 | 79 | 614 | 497 |
| 12 | 93 | 75 | 46 | 357 | 289 | 80 | 622 | 503 |
| 13 | 101 | 82 | 47 | 365 | 296 | 81 | 629 | 510 |
| 14 | 109 | 88 | 48 | 373 | 302 | 82 | 637 | 516 |
| 15 | 116 | 94 | 49 | 381 | 308 | 83 | 645 | 522 |
| 16 | 124 | 101 | 50 | 388 | 315 | 84 | 653 | 529 |
| 17 | 132 | 107 | 51 | 396 | 321 | 85 | 661 | 535 |
| 18 | 140 | 113 | 52 | 404 | 327 | 86 | 668 | 541 |
| 19 | 148 | 119 | 53 | 412 | 334 | 87 | 676 | 547 |
| 20 | 155 | 126 | 54 | 419 | 340 | 88 | 684 | 554 |
| 21 | 163 | 132 | 55 | 427 | 346 | 89 | 692 | 560 |
| 22 | 171 | 138 | 56 | 435 | 352 | 90 | 699 | 566 |
| 23 | 179 | 145 | 57 | 443 | 359 | 91 | 707 | 573 |
| 24 | 186 | 151 | 58 | 451 | 365 | 92 | 715 | 579 |
| 25 | 194 | 157 | 59 | 458 | 371 | 93 | 723 | 585 |
| 26 | 202 | 164 | 60 | 466 | 378 | 94 | 731 | 591 |
| 27 | 210 | 170 | 61 | 474 | 384 | 95 | 738 | 598 |
| 28 | 217 | 176 | 62 | 482 | 390 | 96 | 746 | 604 |
| 29 | 225 | 182 | 63 | 489 | 396 | 97 | 754 | 610 |
| 30 | 233 | 189 | 64 | 497 | 403 | 98 | 762 | 617 |
| 31 | 241 | 195 | 65 | 505 | 409 | 99 | 769 | 623 |
| 32 | 249 | 201 | 66 | 513 | 415 | 100 | 777 | 629 |
| 33 | 256 | 208 | 67 | 521 | 422 | 200 | 1554 | 1259 |
| 34 | 264 | 214 | 68 | 528 | 428 | 300 | 2331 | 1888 |

| M | 40d | 50d. | M | 40d | 50d | Min. | 40d. | 50d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 8 | 6 | 35 | 268 | 225 | 69 | 529 | 443 |
| 2 | 15 | 13 | 36 | 276 | 231 | 70 | 536 | 450 |
| 3 | 23 | 19 | 37 | 283 | 238 | 71 | 544 | 456 |
| 4 | 31 | 26 | 38 | 291 | 244 | 72 | 552 | 463 |
| 5 | 38 | 32 | 39 | 299 | 251 | 73 | 559 | 469 |
| 6 | 46 | 38 | 40 | 306 | 257 | 74 | 567 | 476 |
| 7 | 54 | 45 | 41 | 314 | 263 | 75 | 574 | 482 |
| 8 | 61 | 51 | 42 | 322 | 270 | 76 | 582 | 489 |
| 9 | 69 | 58 | 43 | 329 | 276 | 77 | 590 | 495 |
| 10 | 77 | 64 | 44 | 337 | 283 | 78 | 597 | 501 |
| 11 | 84 | 71 | 45 | 345 | 289 | 79 | 605 | 508 |
| 12 | 92 | 77 | 46 | 352 | 296 | 80 | 613 | 514 |
| 13 | 100 | 83 | 47 | 360 | 302 | 81 | 620 | 521 |
| 14 | 107 | 90 | 48 | 368 | 309 | 82 | 628 | 527 |
| 15 | 115 | 96 | 49 | 375 | 315 | 83 | 636 | 533 |
| 16 | 123 | 103 | 50 | 383 | 321 | 84 | 643 | 540 |
| 17 | 130 | 109 | 51 | 391 | 328 | 85 | 651 | 546 |
| 18 | 138 | 116 | 52 | 398 | 334 | 86 | 659 | 553 |
| 19 | 146 | 122 | 53 | 406 | 341 | 87 | 666 | 559 |
| 20 | 153 | 129 | 54 | 414 | 347 | 88 | 674 | 566 |
| 21 | 161 | 135 | 55 | 421 | 353 | 89 | 682 | 572 |
| 22 | 169 | 141 | 56 | 429 | 360 | 90 | 689 | 579 |
| 23 | 176 | 148 | 57 | 437 | 366 | 91 | 697 | 585 |
| 24 | 184 | 154 | 58 | 444 | 373 | 92 | 705 | 591 |
| 25 | 192 | 161 | 59 | 452 | 379 | 93 | 712 | 598 |
| 26 | 199 | 167 | 60 | 460 | 386 | 94 | 720 | 604 |
| 27 | 207 | 173 | 61 | 467 | 392 | 95 | 727 | 611 |
| 28 | 214 | 180 | 62 | 475 | 399 | 96 | 735 | 617 |
| 29 | 222 | 186 | 63 | 483 | 405 | 97 | 743 | 623 |
| 30 | 230 | 193 | 64 | 490 | 411 | 98 | 751 | 630 |
| 31 | 237 | 199 | 65 | 498 | 418 | 99 | 758 | 636 |
| 32 | 245 | 206 | 66 | 506 | 424 | 100 | 766 | 643 |
| 33 | 253 | 212 | 67 | 513 | 431 | 200 | 1532 | 1286 |
| 34 | 260 | 219 | 68 | 521 | 437 | 300 | 2298 | 1928 |

| M | 41d | 49 d. |
|---|---|---|
| 1 | 8 | 7 |
| 2 | 15 | 13 |
| 3 | 23 | 20 |
| 4 | 30 | 26 |
| 5 | 38 | 33 |
| 6 | 45 | 39 |
| 7 | 53 | 46 |
| 8 | 60 | 52 |
| 9 | 68 | 59 |
| 10 | 75 | 66 |
| 11 | 83 | 72 |
| 12 | 91 | 79 |
| 13 | 98 | 85 |
| 14 | 106 | 92 |
| 15 | 113 | 98 |
| 16 | 121 | 105 |
| 17 | 128 | 112 |
| 18 | 136 | 118 |
| 19 | 143 | 125 |
| 20 | 151 | 131 |
| 21 | 159 | 138 |
| 22 | 166 | 144 |
| 23 | 174 | 151 |
| 24 | 181 | 157 |
| 25 | 189 | 164 |
| 26 | 196 | 171 |
| 27 | 204 | 177 |
| 28 | 211 | 184 |
| 29 | 219 | 190 |
| 30 | 226 | 197 |
| 31 | 234 | 203 |
| 32 | 241 | 210 |
| 33 | 249 | 216 |
| 34 | 257 | 223 |

| M | 41d | 49d |
|---|---|---|
| 35 | 264 | 229 |
| 36 | 272 | 236 |
| 37 | 279 | 243 |
| 38 | 287 | 249 |
| 39 | 294 | 256 |
| 40 | 302 | 262 |
| 41 | 309 | 269 |
| 42 | 317 | 275 |
| 43 | 324 | 282 |
| 44 | 332 | 289 |
| 45 | 339 | 295 |
| 46 | 347 | 302 |
| 47 | 354 | 308 |
| 48 | 362 | 315 |
| 49 | 369 | 321 |
| 50 | 377 | 328 |
| 51 | 385 | 334 |
| 52 | 392 | 341 |
| 53 | 400 | 348 |
| 54 | 407 | 354 |
| 55 | 415 | 361 |
| 56 | 422 | 367 |
| 57 | 430 | 374 |
| 58 | 438 | 380 |
| 59 | 445 | 387 |
| 60 | 453 | 394 |
| 61 | 460 | 400 |
| 62 | 468 | 407 |
| 63 | 475 | 413 |
| 64 | 483 | 420 |
| 65 | 490 | 426 |
| 66 | 498 | 433 |
| 67 | 506 | 439 |
| 68 | 513 | 446 |

| Min. | 41 d. | 49d. |
|---|---|---|
| 69 | 521 | 452 |
| 70 | 528 | 459 |
| 71 | 536 | 466 |
| 72 | 543 | 472 |
| 73 | 551 | 478 |
| 74 | 558 | 485 |
| 75 | 566 | 492 |
| 76 | 574 | 498 |
| 77 | 581 | 505 |
| 78 | 589 | 512 |
| 79 | 596 | 518 |
| 80 | 604 | 525 |
| 81 | 611 | 531 |
| 82 | 619 | 538 |
| 83 | 626 | 544 |
| 84 | 634 | 551 |
| 85 | 641 | 557 |
| 86 | 649 | 564 |
| 87 | 656 | 571 |
| 88 | 664 | 577 |
| 89 | 671 | 584 |
| 90 | 679 | 590 |
| 91 | 687 | 597 |
| 92 | 694 | 603 |
| 93 | 702 | 610 |
| 94 | 709 | 616 |
| 95 | 717 | 623 |
| 96 | 724 | 629 |
| 97 | 732 | 636 |
| 98 | 739 | 643 |
| 99 | 747 | 649 |
| 100 | 755 | 656 |
| 200 | 1509 | 1312 |
| 300 | 2264 | 1968 |

| M | 42d | 48d | M | 42d | 48d | Min. | 42 d. | 48 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 7 | 35 | 260 | 234 | 69 | 513 | 462 |
| 2 | 15 | 13 | 36 | 267 | 241 | 70 | 520 | 468 |
| 3 | 22 | 20 | 37 | 275 | 247 | 71 | 527 | 475 |
| 4 | 30 | 27 | 38 | 282 | 254 | 72 | 535 | 482 |
| 5 | 37 | 33 | 39 | 290 | 261 | 73 | 542 | 488 |
| 6 | 44 | 40 | 40 | 297 | 268 | 74 | 550 | 495 |
| 7 | 53 | 47 | 41 | 304 | 274 | 75 | 557 | 502 |
| 8 | 59 | 53 | 42 | 312 | 281 | 76 | 564 | 509 |
| 9 | 67 | 60 | 43 | 319 | 287 | 77 | 572 | 515 |
| 10 | 74 | 67 | 44 | 327 | 294 | 78 | 579 | 522 |
| 11 | 82 | 73 | 45 | 334 | 301 | 79 | 587 | 529 |
| 12 | 89 | 80 | 46 | 342 | 308 | 80 | 594 | 535 |
| 13 | 97 | 87 | 47 | 349 | 314 | 81 | 602 | 542 |
| 14 | 104 | 93 | 48 | 357 | 321 | 82 | 609 | 549 |
| 15 | 111 | 100 | 49 | 364 | 328 | 83 | 617 | 555 |
| 16 | 119 | 107 | 50 | 372 | 335 | 84 | 624 | 562 |
| 17 | 126 | 113 | 51 | 379 | 341 | 85 | 632 | 569 |
| 18 | 134 | 120 | 52 | 386 | 348 | 86 | 639 | 575 |
| 19 | 141 | 127 | 53 | 394 | 354 | 87 | 647 | 582 |
| 20 | 149 | 134 | 54 | 401 | 361 | 88 | 654 | 589 |
| 21 | 156 | 140 | 55 | 409 | 368 | 89 | 661 | 595 |
| 22 | 163 | 147 | 56 | 416 | 375 | 90 | 669 | 602 |
| 23 | 171 | 154 | 57 | 423 | 381 | 91 | 676 | 609 |
| 24 | 178 | 160 | 58 | 431 | 388 | 92 | 684 | 615 |
| 25 | 186 | 167 | 59 | 438 | 394 | 93 | 691 | 622 |
| 26 | 193 | 174 | 60 | 446 | 401 | 94 | 699 | 629 |
| 27 | 201 | 180 | 61 | 453 | 408 | 95 | 706 | 635 |
| 28 | 208 | 187 | 62 | 461 | 415 | 96 | 713 | 642 |
| 29 | 215 | 194 | 63 | 468 | 421 | 97 | 721 | 649 |
| 30 | 223 | 201 | 64 | 475 | 428 | 98 | 728 | 655 |
| 31 | 230 | 207 | 65 | 483 | 435 | 99 | 736 | 662 |
| 32 | 238 | 214 | 66 | 490 | 442 | 100 | 743 | 669 |
| 33 | 245 | 221 | 67 | 498 | 448 | 200 | 1486 | 1338 |
| 34 | 253 | 227 | 68 | 505 | 455 | 300 | 2229 | 2007 |

| M | 43d | 47d | M | 43d | 47d | Min. | 43 d. | 47 d. |
|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 7 | 35 | 256 | 239 | 69 | 505 | 470 |
| 2 | 15 | 14 | 36 | 263 | 245 | 70 | 512 | 477 |
| 3 | 22 | 20 | 37 | 270 | 252 | 71 | 519 | 484 |
| 4 | 29 | 27 | 38 | 278 | 259 | 72 | 526 | 491 |
| 5 | 36 | 34 | 39 | 285 | 266 | 73 | 534 | 498 |
| 6 | 44 | 41 | 40 | 292 | 273 | 74 | 541 | 505 |
| 7 | 51 | 48 | 41 | 300 | 280 | 75 | 548 | 511 |
| 8 | 58 | 54 | 42 | 307 | 286 | 76 | 556 | 518 |
| 9 | 66 | 61 | 43 | 314 | 293 | 77 | 563 | 525 |
| 10 | 73 | 68 | 44 | 322 | 300 | 78 | 570 | 532 |
| 11 | 80 | 75 | 45 | 329 | 307 | 79 | 578 | 539 |
| 12 | 88 | 82 | 46 | 336 | 314 | 80 | 585 | 546 |
| 13 | 95 | 89 | 47 | 344 | 320 | 81 | 592 | 552 |
| 14 | 102 | 95 | 48 | 351 | 327 | 82 | 600 | 559 |
| 15 | 110 | 102 | 49 | 358 | 334 | 83 | 607 | 566 |
| 16 | 117 | 109 | 50 | 366 | 341 | 84 | 614 | 573 |
| 17 | 124 | 116 | 51 | 373 | 348 | 85 | 622 | 580 |
| 18 | 132 | 123 | 52 | 380 | 355 | 86 | 629 | 587 |
| 19 | 139 | 130 | 53 | 388 | 361 | 87 | 636 | 593 |
| 20 | 146 | 136 | 54 | 395 | 368 | 88 | 643 | 600 |
| 21 | 153 | 143 | 55 | 402 | 375 | 89 | 651 | 607 |
| 22 | 161 | 150 | 56 | 409 | 382 | 90 | 658 | 614 |
| 23 | 168 | 157 | 57 | 417 | 389 | 91 | 665 | 621 |
| 24 | 175 | 164 | 58 | 424 | 395 | 92 | 673 | 627 |
| 25 | 183 | 170 | 59 | 431 | 402 | 93 | 680 | 634 |
| 26 | 190 | 177 | 60 | 439 | 409 | 94 | 687 | 641 |
| 27 | 197 | 184 | 61 | 446 | 416 | 95 | 695 | 648 |
| 28 | 205 | 191 | 62 | 453 | 423 | 96 | 702 | 655 |
| 29 | 212 | 198 | 63 | 461 | 430 | 97 | 709 | 661 |
| 30 | 219 | 205 | 64 | 468 | 436 | 98 | 717 | 668 |
| 31 | 227 | 211 | 65 | 475 | 443 | 99 | 724 | 675 |
| 32 | 234 | 218 | 66 | 483 | 450 | 100 | 731 | 682 |
| 33 | 241 | 225 | 67 | 490 | 457 | 200 | 1463 | 1364 |
| 34 | 248 | 232 | 68 | 497 | 464 | 300 | 2194 | 2046 |

| M | 44d | 46 d |
|---|---|---|
| 1 | 7 | 7 |
| 2 | 14 | 14 |
| 3 | 22 | 21 |
| 4 | 29 | 28 |
| 5 | 36 | 35 |
| 6 | 43 | 42 |
| 7 | 50 | 49 |
| 8 | 58 | 56 |
| 9 | 65 | 62 |
| 10 | 72 | 69 |
| 11 | 79 | 76 |
| 12 | 86 | 83 |
| 13 | 93 | 90 |
| 14 | 101 | 97 |
| 15 | 108 | 104 |
| 16 | 115 | 111 |
| 17 | 122 | 118 |
| 18 | 129 | 125 |
| 19 | 137 | 132 |
| 20 | 144 | 149 |
| 21 | 151 | 146 |
| 22 | 158 | 153 |
| 23 | 165 | 160 |
| 24 | 173 | 167 |
| 25 | 180 | 174 |
| 26 | 187 | 181 |
| 27 | 194 | 188 |
| 28 | 201 | 195 |
| 29 | 209 | 201 |
| 30 | 216 | 208 |
| 31 | 223 | 215 |
| 32 | 230 | 222 |
| 33 | 237 | 229 |
| 34 | 245 | 236 |
| 35 | 252 | 243 |
| 36 | 259 | 250 |
| 37 | 266 | 257 |
| 38 | 273 | 264 |
| 39 | 280 | 271 |
| 40 | 288 | 278 |
| 41 | 295 | 285 |
| 42 | 302 | 292 |
| 43 | 309 | 299 |
| 44 | 316 | 306 |
| 45 | 324 | 313 |
| 46 | 331 | 320 |
| 47 | 338 | 327 |
| 48 | 345 | 334 |
| 49 | 352 | 340 |
| 50 | 360 | 347 |
| 51 | 367 | 354 |
| 52 | 374 | 361 |
| 53 | 381 | 368 |
| 54 | 388 | 375 |
| 55 | 396 | 382 |
| 56 | 403 | 389 |
| 57 | 410 | 396 |
| 58 | 417 | 403 |
| 59 | 424 | 410 |
| 60 | 432 | 417 |
| 61 | 439 | 424 |
| 62 | 446 | 431 |
| 63 | 453 | 438 |
| 64 | 460 | 445 |
| 65 | 468 | 452 |
| 66 | 475 | 458 |
| 67 | 482 | 465 |
| 68 | 489 | 472 |

| Min. | 44 d. | 46 d. |
|---|---|---|
| 69 | 496 | 479 |
| 70 | 503 | 486 |
| 71 | 511 | 493 |
| 72 | 518 | 500 |
| 73 | 525 | 507 |
| 74 | 532 | 514 |
| 75 | 539 | 521 |
| 76 | 547 | 528 |
| 77 | 554 | 535 |
| 78 | 561 | 542 |
| 79 | 568 | 549 |
| 80 | 575 | 556 |
| 81 | 583 | 563 |
| 82 | 590 | 570 |
| 83 | 597 | 577 |
| 84 | 604 | 584 |
| 85 | 611 | 590 |
| 86 | 619 | 597 |
| 87 | 626 | 604 |
| 88 | 633 | 611 |
| 89 | 640 | 618 |
| 90 | 647 | 625 |
| 91 | 655 | 632 |
| 92 | 662 | 639 |
| 93 | 669 | 646 |
| 94 | 676 | 653 |
| 95 | 683 | 660 |
| 96 | 690 | 667 |
| 97 | 698 | 674 |
| 98 | 705 | 681 |
| 99 | 712 | 688 |
| 100 | 719 | 695 |
| 200 | 1439 | 1385 |
| 300 | 2158 | 2084 |

| M | 45d | 45 d |
|---|---|---|
| 1 | 7 | 7 |
| 2 | 14 | 14 |
| 3 | 21 | 21 |
| 4 | 28 | 28 |
| 5 | 35 | 35 |
| 6 | 42 | 42 |
| 7 | 49 | 49 |
| 8 | 56 | 56 |
| 9 | 64 | 64 |
| 10 | 71 | 71 |
| 11 | 78 | 78 |
| 12 | 85 | 85 |
| 13 | 92 | 92 |
| 14 | 99 | 99 |
| 15 | 106 | 106 |
| 16 | 113 | 113 |
| 17 | 120 | 120 |
| 18 | 127 | 127 |
| 19 | 134 | 134 |
| 20 | 141 | 141 |
| 21 | 148 | 148 |
| 22 | 155 | 155 |
| 23 | 163 | 163 |
| 24 | 170 | 170 |
| 25 | 177 | 177 |
| 26 | 184 | 184 |
| 27 | 191 | 191 |
| 28 | 198 | 198 |
| 29 | 205 | 205 |
| 30 | 212 | 212 |
| 31 | 219 | 219 |
| 32 | 226 | 226 |
| 33 | 233 | 233 |
| 34 | 240 | 240 |
| 35 | 247 | 247 |
| 36 | 254 | 254 |
| 37 | 261 | 261 |
| 38 | 268 | 268 |
| 39 | 275 | 275 |
| 40 | 283 | 283 |
| 41 | 290 | 290 |
| 42 | 297 | 297 |
| 43 | 304 | 304 |
| 44 | 311 | 311 |
| 45 | 318 | 318 |
| 46 | 325 | 325 |
| 47 | 332 | 332 |
| 48 | 339 | 339 |
| 49 | 346 | 346 |
| 50 | 353 | 353 |
| 51 | 360 | 360 |
| 52 | 367 | 367 |
| 53 | 375 | 375 |
| 54 | 382 | 382 |
| 55 | 389 | 389 |
| 56 | 396 | 396 |
| 57 | 403 | 403 |
| 58 | 410 | 410 |
| 59 | 417 | 417 |
| 60 | 424 | 424 |
| 61 | 431 | 431 |
| 62 | 438 | 438 |
| 63 | 445 | 445 |
| 64 | 452 | 452 |
| 65 | 459 | 459 |
| 66 | 466 | 466 |
| 67 | 474 | 474 |
| 68 | 481 | 481 |

| Min. | 45 d. | 45 d. |
|---|---|---|
| 69 | 488 | 488 |
| 70 | 495 | 495 |
| 71 | 502 | 502 |
| 72 | 509 | 509 |
| 73 | 516 | 516 |
| 74 | 523 | 523 |
| 75 | 530 | 530 |
| 76 | 537 | 537 |
| 77 | 544 | 544 |
| 78 | 551 | 551 |
| 79 | 558 | 558 |
| 80 | 566 | 566 |
| 81 | 573 | 573 |
| 82 | 580 | 580 |
| 83 | 587 | 587 |
| 84 | 594 | 594 |
| 85 | 601 | 601 |
| 86 | 608 | 608 |
| 87 | 615 | 615 |
| 88 | 622 | 622 |
| 89 | 629 | 629 |
| 90 | 636 | 636 |
| 91 | 643 | 643 |
| 92 | 650 | 650 |
| 93 | 657 | 657 |
| 94 | 665 | 665 |
| 95 | 672 | 672 |
| 96 | 678 | 678 |
| 97 | 686 | 686 |
| 98 | 693 | 693 |
| 99 | 700 | 700 |
| 100 | 707 | 707 |
| 200 | 1414 | 1414 |
| 300 | 2121 | 2121 |

Now for the form of ſetting down a Reckoning, although he which is accuſtomed to keep it in this manner, may haply by uſe and practice diſcern how to order it in a better way then I can preſently preſcribe or think upon, becauſe he hath occaſion often to conſider it in every particular: yet in the mean time I conceive it will be fit to have a Book in *Folio*, that is, two Leaves to a ſheet of paper, and to keep the left ſide of your Book void, that you may write therein all ſuch Occurrents as you ſhall think requiſite. As namely, the Winds, and the Points of the *Compaſſe*, upon which your ſhip lies, and what allowance you make for *Lee-ward*-way when you ſail by winde, the number of Glaſſes or Hours, and how many Knots or Miles in each hour, alſo the Latitudes which you finde by obſervation of the Meridian-altitude of the Stars, and what elſe you ſhall think remarkable. But before all this, the title of the Voyage in theſe or like words.

*The Journal of our Voyage intended by Gods aſſiſtance from* S. I. *in the latitude of* 32 *deg.* 25 *min. to the Coaſt of* England, &c.

The right hand Pages, or the right ſide of your Book throughout, may by lines be divided into 12 Columns, as in the Example following doth appear. In the firſt Column may be expreſſed the *day*, in the ſecond, *moneth*; or at leaſt once in the top of the page; likewiſe in the ſame ſecond column, being large enough, may be ſet down the *Latitudes* which you finde by the *Meridian altitudes* of the Sunne at ſuch times as you make obſervation. In the third col. the courſe (the *Lee-ward way*, if there be any leeing allowed.) In the 4. the *Variation of the Needle*. In the 5. (having made allowance for the *Variation*) ſet down the angle of your *Rumb* with the *Meridian*. In the 6. col. ſet down the *diſtance* in miles run upon that *Rumb*. In the 7, 8, 9, and 10 col. the *Northing*, or *Southing*, *Eaſting*, or *Weſting*, thereto anſwering, as you ſhall finde it by your *Table*. In the 11. your *Latitudes* by dead reckoning. And laſtly, in the 12 column you may at ſuch times as you think fitteſt, ſet down your *Longitude* from the place from which you firſt departed, or the difference of Longitude from place to place.

| da. | Lat. by observation. | course | Variation. | Deg. from the mer | dist. in miles. | North. | South | East | West | Lat. by dead R | Longitude. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | February | N E. by E. | 8deg. west | n e 48d | miles 78 | 522 | | 579 | | 33.17 | |
| 21 | Latitude 34d. 25′ | N E. by E. | 8deg. west. | n e 48d | 100 | 669 | | 743 | | 34.24 | |
| | 34d. 25′ | | | Summe is | | 1191 | | 1321 | | 34.24 | 02.38 |
| 22 | | e n e ½ po. n | 8deg. west | n e 54d | 100 56 | 588 329 | | 809 453 | | 35.56 | |
| 23 | Latitude 37d. 46′ | e n e ½ no. | 8deg. west | n e 54d | 100 78 | 588 458 | | 809 631 | | 37.40 | |
| 24 | Latitude 39d. 36′ | e n e ½ no. | 8deg. west | n e 54d | 100 84 | 588 494 | | 809 679 | | 39.28 | |
| | | | | Summe is | | 3045 | | 4190 | | | |
| | | The correction by observ. is | | | | 80 | | 110 | | 08 | |
| 24 | l. 39. 30 | | | | | 3125 | | 4300 | | 39.36 | 11.36 |
| 25 | February | e n e | 8deg. west. | n e 59½ | 100 76 | 507 385 | | 861 655 | | 41.05 | |
| 26 | | e n e | 8deg. west. | n e 59½ | 100 80 | 507 412 | | 861 686 | | 42.37 | |
| 27 | Latitude 43d. 55′ | e n e | 7½de. west | n e 60d | 100 84 | 500 420 | | 866 728 | | 44.09 | |
| | | | | Summe is | | 2731 | | 4657 | | | |
| | | | | Correction | | | 140 | | 245 | 14 | |
| 27 | l. 43. 55 | | | | | 2591 | | 4412 | | 43.55 | 21.28 |
| 28 | February | e n e ½ e | 6deg west. | n e 67d | 100 51 | 391 199 | | 921 469 | | 44.54 | |
| 29 | | e n e ½ e | 5deg. west. | n e 68d | 100 81 | 375 304 | | 927 751 | | 46.02 | |
| 1 | March | e n e ½ e | 4deg. west. | n e 69d | 100 66 | 358 237 | | 934 616 | | 47.02 | |
| 2 | Lat. 48.4 | e n e ½ e | 2deg. west. | n e 71d | 100 78 | 326 254 | | 946 737 | | 48.00 | |
| 2 | Lat. 48.4 | | | Summe is | | 2444 | | 6201 | | 48.00 | 36.3 |

| da. | Lat. by observation. | cours. | Variation | Deg. fr. the Mer. | di. in miles | North. | South. | East | West | Lat. by dead R | Longitude. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | March | ene ½e | 0 de. west | ne 73d | 1 00 | 292 | | 956 | | 48.44 | | |
| | | | | | 52 | 152 | | 497 | | | | |
| 4 | | ene ½e | 2 de. East | ne 75d | 100 | 259 | | 966 | | 49.28 | | |
| | | | | | 68 | 176 | | 657 | | | | |
| 5 | Latitude 49d.58′ | ene ½e | 3 de. East | ne 76d | 98 | 237 | | 951 | | 49.52 | | |
| 5 | la.49.58 | | | Summe is | | 1116 | | 4027 | | 49.52 | 46.52 | |
| 5 | 8 Hours | nbye ½e | 4 de. East | ne 21d | 18 | 168 | | 64 | | 50.09 | | |
| 6 | | south by e. | 4 de. East | se 7d. | 34 | | 337 | 41 | | 49.35 | | |
| 6 | 16 Hour | n by east | 4 de. East | ne 15d | 36 | 348 | | 93 | | 50.10 | | |
| 7 | | seby east | 4 de. East | se 52d | 20 | | 123 | 158 | | 49.58 | | |
| 8 | Latitude 50d. 4′ | East. | 4 de. East | se 86d | 96 | | 67 | 958 | | 49.51 | | |
| | The current seting by estima. | East nort. east | | ne 67½ | 60 | 230 | | 554 | | 50.14 | | |
| | | | | Summe is | | 219 | | 1868 | | | | |
| | | | | Correction | | | 100 | | | 10 | | |
| 8 | l. 50d. 4′ | | | | | 119 | | 1868 | | 50.04 | 51.43 | |
| 9 | | east½ po.n | 6 de. East | se 89½d | 70 | | 60 | 700 | | 49.58 | | |
| 10 | | east½ po.n | 6 de. East | se 89½d | 52 | | 41 | 520 | | 49.54 | | |
| 10 | March | | | Summe is | | | 101 | 1220 | | 49.54 | 54.53 | |
| | Here the Lizard bears | N by E | | | 13 | | | | | | | |

For an example, we may frame a reckoning between the two places before-mentioned, namely from *Summer-Iſlands* to the *Lizard*, whoſe diſtance in their Rumb we have before ſuppoſed to be 3299 miles, as ſome Charts make it, and conſequently their difference of Longitude 70 deg. I would not be underſtood as if I affirmed it to be ſo much, for I ſuppoſe it is leſſe, I was there indeed about 20 years paſt, and ſurveyed it, and then kept a reckoning both outwards and homewards, but I have loſt thoſe reckonings long ſince, and have forgotten what they were, and in this caſe it matters not, for whether the ſuppoſition be neer the truth or not; it ſerves ſufficiently to exemplifie the rule, that being the end for which it is uſed. But if their diſtance be 3299 ſuch miles as contain onely 1000 paces in a mile, the ſame being reckoned in ſuch miles, as we have before-mentioned, namely, in ſuch whereof 60 make a degree of a great Circle, which as we find contain 6120 feet in a mile: their diſtance will be little more then 2695 miles; and conſequently, the difference of Longitude little more then 55½ degrees.

Let us therefore ſuppoſe the difference of Longitude between thoſe two places to be 55 degrees, and their Latitudes to be the ſame as before, namely, of the 132 deg. 25 min. and of the other 50 degrees. And let the Courſes, Diſtances, and other obſervations from *Summer-Iſlands* to the *Lizard* be ſuch as before is ſhewed.

This firſt entrance in this Journal (which is the 20 day of *February*) is thus to be underſtood; namely, that from the time of ſetting ſail (which we ſuppoſe to be the 19 of *February*) till the 20 day at noon, the Ship lies away, and makes her way good upon the Northeaſt and by E. point of the Compaſſe: but the Variation being 8 deg. to the Weſtwards (as in the fourth column appears) the rumb upon which ſhe hath run is from the North to the Eaſtwards only 48d. as is expreſſed in the 5 Column (it is indeed 48 ¼ deg. but the ¼ deg. we omit as for the other circumſtances not to be regarded) upon this rumb ſhe runs 78 miles, as in the 6 column appears, and anſwerable thereto I find in the table before-going, the Northing to be 52 $\frac{3}{12}$ miles, and the Eaſting 57 $\frac{3}{12}$ miles, as here in the ſeventh and ninth columns is expreſt.

by

by theſe numbers 522 and 529 (for the firſt figure towards the right hand ſignifieth the tenth parts of a mile, the reſt miles.) Hence then the Northing being 52 miles, if that be added to the Latitude from which it is reckoned, namely 32 deg. 25 min. it makes the Latitude here to be 33 deg. 17 min. as in the 11. Column appears. In like ſort, the ſecond entrance being the 21 of *Februarie*, ſheweth that from the 20 day at noon to the 21, ſhe made her way good upon Northeaſt and by Eaſt point of the Compaſſe, but the Variation being 8 deg. Weſterly, the angle of the Rumb with the true Meridian was from the North to the Eaſtwards 48 deg. and ſo ſailing 100 miles, the Northing is $69\frac{9}{10}$ miles, and the Eaſting $74\frac{3}{10}$ miles, ſo that the Latitude now is 34 deg. 24 min. and the like is to be underſtood of all the reſt.

Touching the Longitude expreſſed in the laſt column, although a reckoning may be kept and ſet down without it, yet it is of very good uſe, and how to convert the Eaſting or Weſting (that is, the miles expreſſed in the Eaſt and Weſt columns of your Journal) into deg. and min. of Longitude; we will ſhew afterwards, as alſo how you may eaſily correct your courſe, and give the true courſe or rumb, allowing the Variation.

But firſt to proceed with this Journal, obſerving the Meridian altitude of the Sun upon the 23 and 24 of *Februarie*, I find that my Latitude upon the 24 is 39 deg. 36 min. whereas by dead reckoning it is but 39 deg. 28 min. ſo the difference is 8 more Northerly: but being well aſſured of the Latitude found by Obſervation, I correct the dead reckoning thereby, which may be done by the Rule of Proportion, ſaying;

| | | | |
|---|---|---|---|
| As the Summe of the North column | 3125 | *Co.ar.* | 6.50515 |
| To the ſumme of the Eaſt column, | 4300 | | 3.63347 |
| So the foreſaid increaſe Northerly | 80 | | 1.90309 |
| To the increaſe Eaſterly | 110 | | 2.04171 |

that is, 11 miles: for the firſt place towards the right hand is only for the tenth parts of a mile.

The ſame may alſo ſufficiently be found without the Rule of Proportion, by the foregoing *Table*, onely for looking there under the Degree upon which I have ſailed, namely, under 54 deg.

deg. for 8 miles or 80 tenths of a mile, though I find not the ſame exactly, yet I finde one which is neer it, namely 82, and againſt it in the next collateral column 113, which is 11 $\frac{3}{10}$ miles, (being too much by $\frac{1}{10}$ of a mile, becauſe the other is too much by $\frac{2}{10}$) I adde therefore in the North column of the Journal 8 miles, and the Eaſt column 11 miles; And ſo whereas by dead reckoning, the Northing was but 304 $\frac{5}{10}$ miles, and the Eaſting 419 miles: now having corrected it by obſervation, the Northing is 312 $\frac{5}{10}$ miles, and Eaſting 430 miles.

In like ſort upon the 27 day, I ſhould by dead reckoning be in the Latitude of 44 deg. 09 min. but by a clear and good obſervation I find my ſelf in the Latitude of 43 deg. 55 min. that is, not ſo much Northerly by 14 min. therefore to correct it I put in the South column 14 miles, or 140 tenths, and ſeeing my courſe was between the North and the Eaſt, and that I find my ſelf to be leſs to the Northwards, that is, more to the Southwards then my reckoning, therefore in probability I am alſo leſs to the Eaſtwards, that is, more to the Weſtwards, then my reckoning; But to find how much, I look in the foregoing Table for the degree upon which I have ſailed, being from the North part of the Meridian to the Eaſtwards 60 deg. and under 60 deg. I look for 14 miles, or 140 tenths, and againſt it in the column adjoyning I find 243, which I ſet down in my Journal in the Weſt column, and ſo ſubſtracting the firſt from the North column, the other from the Eaſt: I finde that whereas by dead Reckoning I ſhould be to the Northwards 273 $\frac{5}{10}$ miles, and to the Eaſtwards 465 $\frac{3}{10}$. Now having corrected it by obſervation, I find that from the 24 day till this time I have run mdre Northerly then I was by 259 miles, and one tenth part, and more Eaſterly by 441 $\frac{3}{10}$ miles.

But if your courſe be neer the Eaſt or Weſt, it may ſuffice to correct it in Latitude onely, as in the example of the 8 of *March* appears; for in that caſe you cannot correct the Longitude, but from ſome further ground.

If there be any Current, you may note it as is done in that Example following the 8 of *March*.

Now if you would ſet down this reckoning upon the Plain or Common *Sea-chart*: Firſt, if you deſire to expreſſe every dayes

dayes account, you may begin for the 20 of *February*, and make a prick in your plat that may be from the place from which you set sail to the Northwards $52\frac{3}{10}$ miles, and to the Eastwards $57\frac{9}{10}$; and so will this point be distant from the place of your setting sail 78 miles Northeast, and almost a quarter of a point Easterly: then for the 21 day you make another Prick, which may be from the form to the Northwards $66\frac{9}{10}$ miles, and to the Eastwards $74\frac{1}{10}$ miles, and so you may proceed with the rest. And thus you shall have a prick on the Plot for every day more exactly set down, then could be done after the ordinary way by Course and Distance, or Course and Latitude, especially because in lining the Plot, there are not, nor cannot conveniently be drawn any more then the 32 Points of the *Compasse*, to wit, not half points, quarters, or single Degrees.

But if you desire not to set down every days reckoning (which is not necessary to be done) you may set down every of the Summes, as they are corrected by Observation after the self-same manner.

Or you may adde together all those summes, and so the summe total of the North column will be 1049 miles, and of the East column 2345 miles, therefore in the meridian of the place from which you depart, you may set down to the Northwards of that place 1049 miles, which will fall in the Latitude of 49 deg. 54 min. almost, and from thence in that parallel set down directly to the Eastwards 2345 miles, and there make a prick for the place where the Ship then is the tenth of *March*, and so is all this reckoning set down at once.

If you keep reckoning according to *Mercator*, it will be requisite sometimes to sum up your reckonings past, namely, so often as you make any notable alteration in your course; and so this reckoning or any other may be set down almost as easily on *Mercators-chart*, the difference is, that here you must often alter your *Scale*, because the deg. of Latitude on this *Chart* are not equal, but grow greater and greater towards the Poles. Now then the distance of two places is to be measured by that part of the *Meridian*, which is intercepted between the Latitudes of those

two

two places; Or if both places lie in one and the same Latitude, their Distance is measured by a Degree or other lesse quantity, taken about that Latitude, namely, half above, and half beneath.

Wherefore if you would make a Prick or Traverse-point in *Mercators-chart*, answering to your reckoning for the first day, namely, until the 20 of *February* at noon; it appears by your Journal that Prick must be to the Northwards of the place from which you departed 52 $\frac{2}{10}$ miles, & to the Eastward 57 $\frac{9}{10}$ miles.

Now instead of the *North* or *South* columns, you may more conveniently use the last column but one, shewing in what Latitude every account doth fall; and so it appears, that the Prick for the 20 of *February* must be in the Latitude of 33 deg. 17 min. Therefore in the meridian of the *Summer-Islands* from which you departed make a prick in the *Latitude* of 33 deg. 17 min. and from that prick set down to the Eastwards in the same Latitude 57 $\frac{9}{10}$ miles, and where it ends is the Traverse-point answering to the 20 of *February*: the like may be done for the 21 day, and so for all the rest. This 58 miles may be taken in the meridian from the Latitude of 32 deg. 22 min. to the Latitude of 33 deg. 20 min. or otherwise you may take the half of it which is 29 miles about the middle between both latitudes, and double it.

But it is sufficient to set down the sums of every two or three dayes accounts, or so often as there is any notable Difference in your Course; Thus if you would make a prick in the *Chart*, answering to the 21 of *February*, being the first summe; I see by the Journal, that it must be in the Latitude of 34 deg. 24 min. and to the Eastwards of the place from which I departed 132 $\frac{2}{10}$ miles. Therefore in the meridian of the place from whence I departed, I make a prick in the Latitude of 34 deg. 24 min. and from that prick I set in the same Latitude to the *Eastwards* 132 $\frac{2}{10}$ miles, and where it ends is the Traverse-point answering to the 21 of *February*, being the first sum. This 132 miles may be taken in the meridian within, or a little without the two Latitudes, as before, namely, from 32 deg. 20 min. to 34 deg. 22 min.

In like sort, if you would make a prick for the second sum, being the 24 of *February*, it there appears that it must be in the Latitude of 39 degr. 36 min. and to the *Eastwards* of the Traverse

verſe point laſt before made 430 miles; therefore in the Meridian of that Traverſe point I make a prick in the Latitude of 39 deg. 36 min. and from that Prick I ſet to the Eaſtwards in the ſame Latitude 430 miles, and where that ends is the Traverſe-point anſwering to the 24 day, and the like is to be underſtood of all the reſt.

Now this 430 miles may be taken ſeveral wayes; for firſt, if I take one Degree about the middle of that part of the meridian, which is intercepted between the Latitudes of the two places (as from 36 deg. 30 min. to 37 deg. 30 min.) and that degree ſeven times taken is 420 miles, then about the middle, namely, 37 d. I take 10 min. more, and ſo I have 430 miles.

In like manner, you may take two deg. or 120 miles, to meaſure it thereby, which may be taken from 36 degrees to 38 deg. and the reſidue about 37 degrees, as before, &c.

Or you may take the halt of 430 miles, namely, 215 miles, which is 3 deg. 35 min. which muſt be taken as before, about the middle of that part of the meridian which is intercepted between the two Latitudes, and that doubled is 430 miles to be ſet to the Eaſtwards, as before.

And thus may this or any other Reckoning be ſet down without knowledge of the Longitudes, but more aptly and exactly by ſome Longitudes known, for then ſhall you have in the two laſt columns the ſubſtance and principal ſcope of your reckoning; namely, the Latitudes and Longitudes of all places, as you ſail, which may more eaſily and exactly be expreſt upon this *Chart*, then the Eaſterly or VVeſterly diſtances; Therefore how this alſo may be done, we will ſhew, but firſt ſomething touching the *Compaſſe* and the *Variation* thereof, which ought not to be neglected in a reckoning.

## CHAP. X.

### *Of the Variation of the Compasse, and how to rectifie a Course by the Variation known.*

AMongst all the Mysteries which God hath of late years discovered to the World for the furtherance of *Navigation*, there is none more necessary, nor yet more admirable then that property of the *Needle* touched with the Load-stone, whereby in the vast Ocean where all Land-marks fail, yea even in the darkest nights and closest weather, when neither Sunne nor Starres are to be seene: The Mariner (as it were by a Messenger sent from Heaven) is taught which way to direct his ship; yea, as it were accompanied with a guide towards his desired Port.

For the needle touched, besides other strange properties, hath this, to point out in all quarters of the World, the North and South parts of the *Horizon*, and so having a Card thereto fitted with Rumbs and degrees, it sheweth all Points of the Compasse, and degrees of the Horizon.

Yet very seldome exactly of it self, without some further Art and industry of him that useth it; for though in some places it swerves not, yet in most parts of the World the North and South points of the Needle have some *variation* from the true North and South points of the Horizon to the Eastwards or to the Westwards, which how to discover in kind and quantity, we have shewed heretofore.

It may be thought, (and some men otherwise learned before this Property was fully discovered, have said) that this should be some blemish and imperfection in a stone so precious; But it is so far from being an imperfection, that it makes it so much the more precious? Yet (as I have said) not without the industry of him that useth it. He that is negligent or unskilful to observe it, especially in long Voyages and various Courses, may be led into many dangers by it, because he frames not his mind to the Rule, but the Rule to his mind, imagining it to be what it is not:

and

and hence I ſuppoſe, ſprang that Cuſtome of placing the *Needle* or *Wyars* a point or half a point to the Eaſtwards of the North-point of the Card, thinking by this means to ſhun the labour of obſerving the Variation, which indeed they might, if the Variation were the ſame in all places, and at all times, but becauſe it is not, this doth often increaſe the Errour.

But he that diligently obſerves the Variation, finds (as I ſay) no prejudice in it, onely it requires daily, or once in two or three dayes half an hours work; and this labour it doth abundantly recompence; for by this means he knowes at the preſent how to direct his Courſe, and for the future, by thoſe notes which he keeps of the *Variations* and *Latitudes* by him obſerved, he knows (comming that way again) when he draws neer to any of thoſe places where ſuch Obſervations were made, and ſo falls the more certainly with any place intended.

There is further diſcovered of late a motion or alteration in the Variation of the *Needle*, and this is ſcarce yet certainly diſcovered. But comparing the Variations which were obſerved about fifty years paſt, with the preſent Variations: It appears they are leſſer *Eaſterly*, and more *Weſterly* by 6 or 7 degrees, then they were at that time. For whereas the Variation hath formerly been obſerved neer *London* to be $11\frac{1}{4}$ Degto the Eaſtwards, it doth now ſcarce exceed 4 Degrees. And there is the like alteration (as I have heard by ſome Mariners) in other parts of the World; which we now leave to the further diſcovery of time and induſtry, and come to ſhew how to rectifie a Courſe by the Variation known.

*The point of the Compaſſe upon which you ſail, and the Variation of the Needle known, to find the Rumb or Degree upon which the Ship hath made her way.*

IT is beſt that the *Needle* or *Wyars* be placed directly under the *Flower de luce*, or *North* and *South* points of the *Card*, and ſo in the Rules following we pre-ſuppoſe them to be. Now then it is to be underſtood, that the *Needle* having Variation

(as for the moſt part it hath) the ſhip doth not make her way upon that Rumb or Point of the Compaſſe, which ſhe ſeems to ſail upon, but either more to the right hand or to the left, according as the Variation is towards the right hand, or towards the left, and that ſo much towards the one ſide, or towards the other as that Variation is: VVe ſpeak not here of *Leeward-way*, but of the Variation onely. Therefore for the ſolution of this *Probleme* you muſt know how much the Variation is, and which way; And how this may be done, we have briefly ſhewed upon the 12 Caſe of *Right angled Spherial triangles*, and the 11 of *Oblique*, which known, you may find the angle of the Rumb or Line of your ſhips way of the *Meridian*: being the thing in this *Probleme* required.

*A Table of the Angles of every Point and half Point of the Compaſſe with the Meridian.*

| | North | South | D. M. | North | South |
|---|---|---|---|---|---|
| ½ | | | 00 00 | | |
| | | | 05 37 | | |
| 1 | N by E. | S by W | 11 15 | N by W | S by E |
| 1½ | | | 16 52 | | |
| 2 | N N E | S S W | 22 30 | N N W | S S E |
| 2½ | | | 28 07 | | |
| 3 | NE by N | S W by S | 33 45 | N W by N | S E by S |
| 3½ | | | 39 22 | | |
| 4 | N E | S W | 45 00 | N W | S E |
| 4½ | | | 50 37 | | |
| 5 | N E by E | S W by W | 56 15 | N W by W | S E by E |
| 5½ | | | 61 52 | | |
| 6 | E N E | W S W | 67 30 | V V N V V | E S E |
| 6½ | | | 73 07 | | |
| 7 | E by N | W by S | 78 45 | V V by N | E by S |
| 7½ | | | 84 22 | | |
| 8 | East | West | 90 00 | V V est | East |
| | Adde East variation Subtract V V eſt. | | | Adde V V eſt variation Subtract East | |

For

For the effecting whereof, we will set down two wayes; the one by the Pen alone, the other Instrumentally. If you do it by the Pen alone, although it be not hard to find what angle every point or half point makes with the Meridian; yet for your further ease herein, I have expressed the same in the Table before-going; the quarters of Points I have omitted, because the steerage upon a quarter of a point is very uncertain, (the points being undivided as usually they are) for a man by his eye is able to guesse very neerly which is the middle between two points, but he cannot guesse so neerly, which is the fourth part. Yet if you desire any quarter, you may adde to the next before-going almost 3 deg. namely 2 deg. 49 min.

Now then by the Magnetical Rumb or Point of the Compasse and Variation given, to find the true Rumb, you are to observe these two Rules following.

1. *If the Rumb and the Variation be both the same way from the Meridian (namely, both to the right hand, or both to the left) adde them together, and that summe is the true Rumb from that part of the Meridian.*

*Yet if that summe exceed 90 degrees, substract it from 180 degrees, the remainer is the Rumb from the opposite part of the Meridian.*

2 *If the one be towards the right hand, the other towards the left, substract the variation from the Rumb, and the remainer is the true Rumb.*

*Yet if the Rumb be the smaller number, substract it from the Variation, and the remainer is the true Rumb the other way.*

These Rules we shall indeavour to illustrate by examples following.

But first, for distinction-sake we say the Rumbs or degrees from the North towards the East, are towards the right hand, and so from the South towards the VVest; but from the North to the VVestwards, on the left hand, and so from the South Eastwards: For a mans face being towards the North, the East is on his right hand, and the VVest on his left, &c.

In like sort for the *variation of the Compasse*, if it have Easterly *variation*, that is, if the *Needle* & *Flower-deluce* of the *Card* stand

ſtand to the Eaſtwards of the North, we ſay that *Variation* is towards the right hand, for not onely the North point but all the other points of the *Compaſſe* direct a Courſe more towards the right hand then they would do, if there were no *Variation*. And ſo if it have Weſterly *variation*; that is, if the *Needle* and *Flower de luce* ſtand to the Weſtwards of the true North-point of the *Horizon*, we ſay that *Variation* is towards the left hand; foraſmuch as not onely the North-point, but all the other points of the Compaſſe, ſtand more towards the left hand then they would do, if there were no *Variation*, this being premiſed, we come to give *Examples* of the two Rules before-going.

1 Let the Magnetical Rumb or Point of the *Compaſſe* be Northeaſt, and the *Variation* 10 degrees to the Eaſtwards; I demand the true *Rumb*?

Here the *Rumb* and *Variation* are both one way; that is, both towards the right hand; therefore,

| | |
|---|---|
| To the Magnetical Rumb being N.Eaſterly | 45 deg. 0 m. |
| Adde the Variation Eaſterly | 10 deg. 0 m. |
| The ſumme is the true Rumb N.Eaſterly, | 55 deg. 0 m. |

2 Admit a ſhip ſail upon the North-point of the Compaſſe, and that the Variation be 10 deg. to the Eaſtwards, how doth ſhe make her way?

| | |
|---|---|
| The Magnetical Rumb is North, that is, | 0 deg. 0 m. |
| To which adding the Eaſterly Variation | 10 deg. 0 m. |
| The ſumme is the angle from the North part of the Meridian to the Eaſtwards | 10 deg. 0 m. |

Which is almoſt *N* by *Eaſt*, & ſo hath the ſhip made her way.

3 Let the point of the compaſſe be Eaſt $\frac{1}{2}$ point Northerly, that is, from the North to the Eaſtwards $7\frac{1}{2}$ points, which is 84 deg. 22 min. and the Variation as before 10 deg. to the Eaſtward, I demand the true Rumb?

| | |
|---|---|
| To the Magnetical Rumb being Northeaſt, | 84 deg. 22 m. |
| Adde the Eaſterly Variation | 10 deg. 00 m. |
| The ſumme is the angle from the North | 94 deg. 22 m. |
| Which ſubtracted from | 180 deg. 00 m. |
| There reſts the true Rumb South-eaſterly | 85 deg. 38 m. |

4 *Ex-*

4 *Example.* Let the course by the Compasse be VVest and by South, that is, 7 points from the South to the VVestwards, or 78 deg. 45 min. and let the Variation be as before 10 deg. to the Eastwards, what is the true Rumb?

| | |
|---|---|
| To the Magnetical Rumb *S Westerly* | 78 deg. 45 min. |
| Adde the *Easterly Variation* | 10 deg. 00 min. |
| The summe is the true Rumb *S Westerly* | 88 deg. 45 min. |

You may conceive that the *Rumb* and *Variation* are here both one way; namely, both from the *Meridian* towards the right hand. For the Variation of the *North* point is from the *North* towards the *East*, and consequently of the *South* point from the *South* towards the *West*, both towards the right hand of the *Meridian*, as the *Rumb* is.

5 *Example.* Let the course by the *Compasse* be *West*, that is, from the *South* to the *Westwards* 8 points or 90 degrees, and let the Variation be as before 10 deg. to the *Eastwards*, I would know the true Course or Rumb?

| | |
|---|---|
| To the Magnetical Rumb South-west | 90 deg. 0 m. |
| Adde the Variation *Easterly* | 10 deg. 0 m. |
| The summe is the angle with the *South* part of the *Meridian* | 100 deg. 0 m. |
| VVhich substracted from | 180 deg. 0 m. |
| There rests the true Rumb *N West* | 80 deg. 0 min. |

Let the Course by the *Compasse* be *West*, that is, from the *North* to the *Westwards* 8 points or 90 degrees, and let the *Variation* be 10 deg. to the *Westwards*: I demand the true Rumb?

| | |
|---|---|
| To the Magnetical Rumb *N West* | 90 deg. 0 min. |
| Adde the Variation *Westerly* | 10 deg. 0 min. |
| The summ is | 100 deg. 0 min. |
| VVhich substracted from | 180 deg. 0 min. |
| There remains the true Rumb S *West* | 80 deg. 0 min. |

*Object.* The Magnetical Rumb being here *West* 90 deg. why should it not aswell be counted from the *South* as from the *North*?

*Answ.* It may be counted from either, for as it is counted here from the North to the VVestwards, it falls under the first *Rule*, because

becauſe the Variation is the ſame way: But if it be reckoned from the South to the Weſtwards, it falls under the ſecond *Rule*, whereof we now come to give ſome *Examples*, ſuppoſing theſe already given ſufficient to illuſtrate the firſt Rule?

7 *Example.* Let the point of the *Compaſſe* be N N VV and the Variation 10 deg. Eaſterly, I demand the true Rumb:

| | |
|---|---|
| From the Magnetical Rumb N W | 22 deg. 30 min. |
| Subtract the Eaſterly Variation | 10 deg. 00 min. |
| The remainer is the true Rumb N W | 12 deg. 30 min. |

8 *Example.* Let the point of the *Compaſſe* be North, and the Variation Eaſterly 10 deg. what is the true Rumb?

| | |
|---|---|
| From the Eaſterly variation | 10 deg. 0 min. |
| Subſtract the Magnetical Rumb Nw. | 00 deg. 0 min. |
| The remainer is the true Rumb, the other way, namely N E. | 10 deg. 0 min. |

*Object.* The Magnetical Rumb may aſwell be named North Eaſterly 0 deg. 0 min.

*Anſw.* It may, but then it is ſubject to the firſt Rule, as in the ſecond *Example*.

9 *Example.* Let the Courſe by the *Compaſſe* be Weſt, that is, from the North to the VVeſtwards 8 points, or 90 degrees, and let the variation be as before 10 degrees to the Eaſtwards, what is the true Rumb?

| | |
|---|---|
| From the Magnetical Rumb N w | 90 deg. 00 min. |
| Subſtract the Eaſterly variation | 10 deg. 00 min. |
| There reſts the true Rumb Nw | 80 deg. 00 min. |

Here the Magnetical Rumb might aſwell have been South-weſterly 90 degr. and ſo it had fallen under the firſt Rule, as in the fifth example.

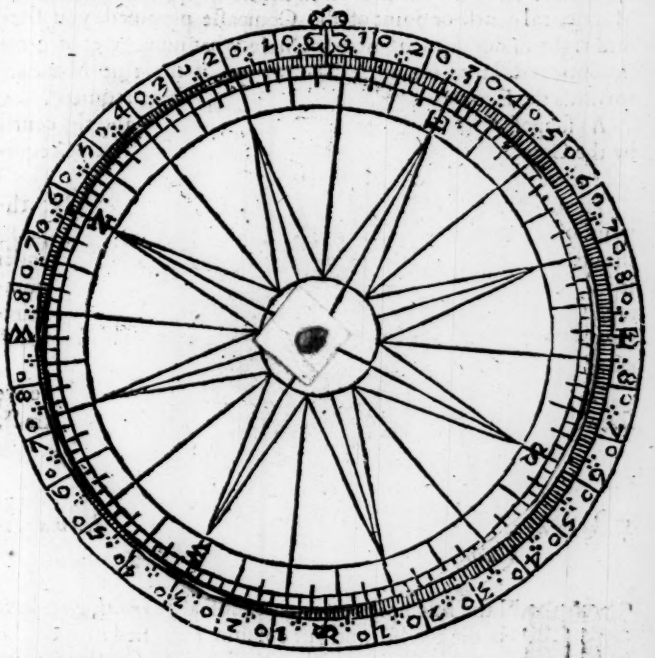
10 *Example.* Let the Courſe by the Compaſſe be VVeſt; that is, from the South to the weſtwards 8 points or 90 degrees, and let the variation be 10 deg. to the weſtwards, I demand the true Rumb?

| | |
|---|---|
| From the Magnetical Rumb Sw. | 90 deg. 0 min. |
| Subtract the *VVeſterly* variation | 10 deg. 0 min. |
| The remainer is the true Rumb Sw | 80 deg. 0 min. |

If

If the Rumb here had been reckoned from the North, as in the ſixth *Example*, it had fallen under the firſt *Rule*.

And this may ſuffice for the illuſtration of the two former Rule in the ſolution of this *Probleme*.



The ſame may alſo more eaſily be reſolved, by ſuch an *Inſtrument* as is here deſcribed, conſiſting of two *Circles*, the one being the nethermoſt divided into four *Quadrants*, and every of thoſe into 90 degr. numbred from the *North* and *South* points, towards the *Eaſt* and *Weſt*.

The other being the uppermoſt and moveable about the *Center* divided, as the Card of the Compaſſe into XXXII *Points*, and thoſe again ſub-divided into *halves* and *quarters*.

By this you may readily find the true Rumb for any Course and Variation given.

For if you turn the North point of the upper Circle, from the North point of the lower, so many deg. and the same way that the Variation is, and then look in the same upper Circle for the Magnetical course or point of the Compasse proposed, you shall find right under it in the nether Circle what number of degrees the same is distant from the N. or S. points of the true Meridian towards the E. or W. which is the true Rumb here required.

As suppose the Variation to be 10 deg. Easterly, and the course by the Compasse East half a point Northerly, and there be required the true Rumb?

Turn the North-point of the upper Circle from the North-point of the lower 10 deg. to the Eastwards, and then I look in the upper Circle, for East half a point Northerly, and right under it in the nether Circle I find 85 deg. and about one half numbred from the South part of the Meridian towards the East, therefore, I conclude that the true Rumb required is from the South towards the East, 85½ degrees and something more.

By this *Instrument* also (if you use the pen onely, as before we shewed) you shall readily see when to add, & when to substract.

## CHAP. XI.

### *To keep a reckoning of your longitude, and so to set down a reckoning by longitude and latitude onely.*

IN the Example before given of a *Journal*, we have in the twelfth and last column expressed in such places as it seemed most requisite, the *Longitudes*, we come now to shew how the same may be known, and first,

*By the Rumb and Latitudes given: to find the Difference of Longitude.*

As *Radius* is in proportion, to the Tangent of the Rumb;
So is the Difference of Latitude in Meridional parts,
To the Difference of Longitude in minutes.

As let the Rumb be North-easterly 48 degrees, and suppose a Ship to run upon this Rumb, from the Latitude of 32 degrees 25 min.

min. into the Latitude of 34 deg. 24 min. there is required the difference of Longitude. Here,

| | | |
|---|---|---|
| The Meridional parts answering to 34 deg. 24 min. | | 2200 |
| The Meridional parts for | 32 25 | 2058 |
| The difference of latitude in such parts is | | 142 |

Say then, As *Radius* is in proportion

| | | |
|---|---|---|
| To the tangent of the Rumb, 48 d. 0 min. | | 10.0456 |
| So the difference of latitude in merid. parts | 142 | 2.1523 |
| To the difference of Longitude in minutes | 158 | 2.1979 |

These Minutes converted into deg. are 2 deg. 38 min. which is the difference of Longitude required, as the same is expressed in the Journal against the 21 of *February*.

And thus sailing upon one and the same Rumb, you may find the difference of Longitude, and so often as you alter your Rumb, so often working by the same Rule you shall have all the differences from place to place, which added together, make the whole difference of Longitude.

But you may also find the Difference of Longitude neer enough at one operation for many several Rumbs and Distances, provided that those Rumbs differ not much one from another. As in the former Journal from the 27 of *February* till the second of *March*, I sail by several Rumbs and Distances from the Latitude of 43 deg. 55 m. into the Latitude of 48 deg. if you would finde the difference of Longitude hereto answerable at one operation, it may be done by this Rule:

As the difference of Longitude in miles,
Is to the departure from the Meridian in miles.
So is the difference of Latitude in meridional parts,
To the difference of Longitude in minutes.

As in that example, the difference of Latitude for all those Courses, as in the North column appears is 2444.

The departure from the Meridian, as there in the East column appears is 6301.

| | |
|---|---|
| The merid. parts for the latitude of 43 deg. 55 min. are | 2939 |
| The merid. parts for the latitude of 48 d. 0 m. are | 3292 |
| Difference of latitude in meridional parts is | 353 |

Say then, As the difference of Latitude 2444 *co. ar.* 6.6119
To the departure from the Meridian 6301 3.7994
So the difference of Latitude in Merid. parts 353 2.5478
To the difference of Longitude in minutes, 910 2.9591

VVhich reduced into degrees, is 15 deg. 10 min. And added to the former Longitude 21 deg. 28 min.

Gives the present Longitude 36 deg. 38 m. for the 2 of *March*.

The like may be done for the account from the second of *March* to the fifth of the same, &c.

But if your Courses and Distances run, be all neer to one and the same Parallel and Latitude, as in this Journal they are from the 5 of *March* to the 8, and from the 8 to the 10) then it is sufficient to finde what Longitude in that Parallel is answerable to the miles of Easting or VVesting, or departure from the Meridian by this Rule.

As the sine complement of the Latitude of that Parallel,
Is in proportion to *Radius*;
So is the number of Miles in that parallel,
To the difference of Longitude in minutes.

As from the 5 of *March* to the 8. the Latitude was neer 50 deg. the Easterly distance 186 $\frac{1}{10}$ miles: therefore for the difference of Longitude, say:

As sine complement the Latitude, *s c* 50 deg. 0 min. 1919
To *Radius*;
So is the departure from the Meridian 186 8 3.2714
To the difference of Longitude 290 6 3.4633

Thus it appears, the difference of Longitude is almost 291 minutes, which is 4 deg. 51 min. and this added to the Longitude upon the 5 of *March*, namely, to 46 deg. 52 min. the sum is 51 deg. 43 min. the Longitude upon the 8 of *March*: the like might be done for the 10 of *March*.

And though this last Rule be then fittest to be used, when your Course is neer East and West, or your difference of Latitude little; yet it may also be used at other times instead of the two former, without any great errour, if you take the middle degree of Latitude, or somewhat more, as in the former Example.

The

The Latitude upon the 27 of *February* is 43 deg. 55 min.
The Latitude upon the second of *March* is 48 deg. 0 min.
The middle Latitude or somewhat more is 46 deg. 10 min.

Say then, As sine comp. the latitude *sc* 46 deg. 10 m. .1595
To Radius,
So the Easting or departure from the Meridian 620. 1. 3.7994
To the difference of Longitude, 909.7. 3.9589
Which is almost 910 min. or 15 deg. 10 m. as before.

And thus you may in the 12th. and last column of your Journal, set down your Longitude so often as you think it requisite; and so in the two last columns you shall have the Substance and principal scope of your Reckoning, namely, your Latitudes and Longitudes, which whensoever you desire to set down in *Mercators Chart*, or in the *polar Chart*, or in any other, graduated with degrees of Longitude and Latitude, you may readily do it.

As if I would set down the summe of the foresaid *Journal*, from the 19 of *February*, to the 10 of *March*: I finde against the 10 of *March* the latitude to be 49 deg. 54 min. and the difference of Longitude 54 deg. 53 min, Therefore in the latitude of 49 deg. 54 min. I draw an occult parallel, and reckoning from the *Summer-Islands* towards the East 54 deg. 53 min: I draw by that Longitude an occult Meridian, the intersection of this Meridian with the foresaid Parallel is the Traverse-point, or the point representing the place of the Ship, and the like is to be understood of any other.

This form of keeping and expressing a Reckoning, is (as I conceive) most apt and agreeable (of all others that I have seen or thought upon) to all sorts of *Charts* or *Maps*, and to the *Globe* it self, and to all the kinds or ways of Sailing, that are or may be be used. We will here adde some other Propositions which may sometimes be of good and necessary use in it.

*The Rumb and Difference of Latitude given: to find by the table, the distance in the Rumb, and the Departure from the Meridian thereto answerable, &c.*

HOw to find the Northing or Southing, that is, the Distance in latitude, as also the Easting or Westing, that is, the Distances

ſtance in Longitude or departure from the Meridian of any Rumb, for any diſtance run upon it we have before ſhewed, the like operation is in theſe Propoſitions following: namely,

2 *The Rumb and diſtance in latitude given: to finde the diſtance in the Rumb, and the Eaſting or Weſting.*

3 *The diſtance and difference in latitude given: to finde the departure from the Meridian and the Rumb.*

4 *The difference in latitude, and departure from the Meridian given: to find the Courſe and Diſtance.*

5 *The Courſe and Departure from the Meridian given: to find the Difference of latitude and Diſtance.*

6 *The Diſtance and Departure from the Meridian given: to find the Courſe and difference of latitude.*

So that with the firſt before-handled, here are ſix Propoſitions, and in every of them two things required, and ſo they become twelve. VVe will not ſtand to give examples of them all, but onely of thoſe which are moſt uſeful, the reſt may by them be conceived.

And firſt, to find the Eaſting or VVeſting of any *Rumb* for any difference of Latitude.

Admit a ſhip run North-eaſterly 60 degr. (that is, NE by E, and almoſt half a point Eaſterly) till ſhe have altered the latitude 42 min. how much is ſhe departed from the Meridian?

I run down the column under 60 deg. till I find 42 miles, or 420 tenths, and againſt it in the adjacent column I find 720 tenths, that is, almoſt 73 miles, which is the departure from the meridian to the Eaſtwards.

If you would alſo have the Diſtance upon the Rumb, it is right againſt theſe numbers in the column of *Diſtances*, being in this Example 84 miles.

2 *Example.* But admit ſhe run North-eaſterly 60 deg. till ſhe alter her latitude 2 deg. 32 m. what is the Eaſterly diſtance?

This 1 deg. 32 min. is 92 miles, or 920 tenths, for which if I look in the column under 60 degr. I find no number ſo great, but the greateſt number there is 500, which ſubtracted from 928, there remains 420, therefore in that column under 60d.

| | | |
|---|---|---|
| 100 | 500 | 866 |
| 84 | 420 | 728 |
| 184 | 920 | 1594 |

I look for these two numbers, namely, 500 and 420, and against the first in the adjacent column I find 866, and against the second 728, which I set against them as above appeareth, and so adding them, I find for this difference of Latitude, the departure from the Meridian to be 159 $\frac{4}{10}$ miles.

If further you desire the Distance run upon this Rumb, you have it in the column of Distances, right against the same numbers, as in the example above appeareth, where being added, it amounts to 184 miles.

*The Distance and difference in Latitude given: to find the Rumb and departure from the Meridian.*

A Amit a ship run upon some Rumb between the North and the East 84 miles, and then have altered her Latitude 42 m. the question is, upon what Rumb hath she run, and how many miles is she to the Eastward in Longitude.

I run crosse the Table towards the right hand, looking in every first column of Distances for 84, till I finde against it in one of the adjacent columns 420, at the top of which column over 420, there is 60 deg. shewing the Rumb to be North-easterly 60 deg. also against 420 in the adjacent column I find 788, which sheweth the Distance to the Eastwards to be almost 73 miles.

2 *Example.* But if the Distance run be 184 miles, and the difference of latitude 1 deg. 32 min. and there be required the Rumb and Distance to the Eastwards?

Because the Column of Distances extends but to 100 miles, and the Distance here given is 184 miles, you may take the half thereof, which is 92 miles, and likewise the half of 1 deg. 32 min. which is 46 miles, or 460 tenths, and then look, as before, where you find 460 against 92, for there in the top of the column you shall find the Rumb, which in this example is 60 deg. shewing that the Rumb is from the North Easterly 60 deg. and in the adjacent column against 92 and 460, you shall find 797, which doubled (because it is for the half) is 1594, shewing that the departure from the Meridian to the Eastwards is 159 $\frac{4}{10}$ miles. These and the rest may also be performed by the *Doctrine of plain triangles*, as we have formerly shewed.

CHAP.

## CHAP. XII.

### *Certain Problemes touching Currents.*

ALthough the time be already expired which I assigned for this VVork, and mine own more urgent occasions call me away: yet seeing it is necessary in Navigation to take notice of Currents, and to make a competent allowance for them: I will briefly set down certain *Problemes*, such as I have sometimes thought upon, whereby a man may the better conceive and judge of that allowance, the rather for that I know not any that hath handled it.

First, then it is to be conceived, that a Ship or other Vessel sailing or rowing where there is a Current hath a compound motion arising of two different Principles; namely, of the Currrent and Ships way, so that here are three Motions to be considered, namely, two simple, and the third compounded of them. The first simple motion is that of the Current, whereby it moveth, and is apt to move other things that are in it the same way. The second of the Ship or Boat, as it moveth by wind or oares, or is apt to be moved, if there were no current: The third, compounded of them, is the line of the Ships true motion. The first, we call the way, or motion of the Current: the second, the way or simple motion of the Ship: the third, her compound or true way. The two simple motions being either of them according to right lines and uniform, (as in the *Problemes* following, we suppose them to be.) The third also, which is composed of them is a right line: For whether the Ship sail directly opposite against the Current, or directly with it the same way, or whether the one crosse the other at right angles or at oblique, yet still either motion being direct and uniform they both together beget a right-lined uniform motion, because the one retaineth to the other one and the same proportion in every point. And according to these grounds we proceed in the Problemes following, to determine the proportions of every of these Motions, and the angles which they make one with another.

1 *Admit a Current run East 3 miles an hour, and that a ſhip under ſail run VVeſt directly againſt it 6 miles an hour in her ſimple motion; what is her true or compound motion?*

| | |
|---|---|
| From the ſhips ſimple motion | 6 miles |
| Subtract the Current | 3 miles |
| The remainer is the ſhips true motion | 3 miles |

So the ſhips true way is to the weſtwards 3 miles an hour.

2 *Admit a Current run weſt 6 miles an hour, and that a ſhip under ſail run directly againſt it, 5 miles an hour by the Log: what is the ſhips compound motion, and which way?*

| | |
|---|---|
| From the Current being the greater | 6 miles |
| Subtract the ſhips ſimple motion | 5 miles |
| There remains the ſhips true motion | 1 mile. |

VVhich 1 mile ſhews, that the ſhip by her compound motion falls a ſtern, that is, moves to the weſtwards 1 mile an hour.

In the Experimental practice of the two former *Problems*, it may ſeem that a ſhip or Boat ſo ordered, hath alſo a motion to the right hand, or to the left, but this comes to paſſe, becauſe it is hard, and in a manner impoſſible to ſtemme a Tide or ſtream ſo exactly, but that the ſhip will ſwerve, (or yaw as they ſay) either to the one ſide, or to the other.

3 *Admit a Current run East 3 miles an hour, and that the ſhip alſo run East 3 miles an hour by the Log, what is the ſhips true motion?*

| | |
|---|---|
| To the ſhips ſimple motion | 3 miles |
| Adde the Current | 3 miles |
| The ſumme is the ſhips true motion | 6 miles |

So the ſhips compound or true way is East 6 miles an hour.

4 *Admit a Current run East two miles an hour, and the ſhip South 6 miles an hour; what is the ſhips true motion, and which way?*

In handling of any Art, to avoid circumlocution, there are uſed terms or words of Art, ſerving to expreſſe briefly the things handled. And foraſmuch as this ſubject hath not been formerly handled, nor the Principles or Grounds thereof laid (ſo farre as I know) we will adde a few ſuch terms as may ſeem moſt neceſſary, expreſſing here what we mean by them.


Let the line A B run from A to the southwards, and B D from B to the Eastwards, and let A B be in proportion to B D, as 6 to 2, or 3 to 1.

Then doth A B represent the line of the ships simple motion, B D the motion of the Current, and A D the compound motion of the ship.

And D A B is the angle contained between the line of the ships simple motion, and the line of her compound or true motion, which for brevities sake we will henceforth call the *Angle of Deflection.* Also A D B is the angle contained between the line of the ships compound motion, and the sett or drift of the Current, which we will call *the angle* of *Reflection.*

Lastly, A B D is the angle contained between the line of the ships simple motion, and the set of the Current, which we will call *the angle of Incidence.*

*Then for the Rumb, the Proportion is thus:*

| | | | |
|---|---|---|---|
| As the simple motion | *A B* 6 miles | *co.ar.* | 9.2219 |
| Is to the Current | *B D* 2 miles | | 0.3011 |
| So is *Radius* | | | |
| To the tangent of Deflection | *t D A B* 18 deg. 26 min. | | 9.5230 |

So the Rumb upon which the ship makes her way good is south 18 degr. 26 min. Easterly, that is, *S S E* 4 degrees 4 minutes southerly.

2 *For the ships true way, or compound motion.*

| | | | |
|---|---|---|---|
| As the sine of the Deflection | *s D A B* 18deg. 26 min. | | 0.5000 |
| To the Current | D B 2 miles | | 0.3011 |
| So *Radius* | | | |
| To the true motion | A D $6\frac{33}{100}$ | | 0.8011 |

So the ships compound motion is $6\frac{33}{100}$ miles hourly, that is $6\frac{1}{3}$ miles almost.

5 *A ship sails West five dayes together by the Log 725 miles, but there is a Current, all this while setting to the Southwards* $\frac{1}{2}$ *mile an hour: I demand how she hath sailed, and how far?*

The Current setting $\frac{1}{2}$ mile an hour, sets in 5 dayes 180 miles:

Therefore,

As

| | | | |
|---|---|---|---|
| As the ſimple motion | A B 725 miles | | 7.1397 |
| Is to the Current | D B 180 miles | | 2.2553 |
| So is *Radius*, | | | |
| To the tangent of Deflection | *t* D A B 13 d. 57 m. | | 9.3950 |
| | *For the Diſtance.* | | |
| As ſine compl. the Deflection | *sc* D A B 13 d. 57 m. | | 9.0130 |
| Is to the ſimple motion A B | 725 miles | | 2.8603 |
| So is Radius | | | |
| To the compound motion A D, | 747 miles. | | 2.8703 |

So the ſhips true way is Weſt ſoutherly 13 deg. 57 min. or South-weſterly 76 deg. 3 min. 747 miles.

6 *A ſhip ſails Weſt five dayes together by the Log 725 miles, in a Current ſetting to the Southwards, and then he finds that he hath altered his Latitude 3 degrees; I demand the motion of the Current, the true Rumb, and true way of the ſhip?*

This Queſtion differeth little from the former, for ſeeing the difference of Latitude is 3 deg. the motion of the Current is 180 miles: ſo there is given the ſhips ſimple motion, and the motion of the Current, as before, &c.

7 *A ſhip in 6 hours ſails from a certain* Cape *or Head-land South 30 miles by the Log, in a Current ſetting Eaſterly, and then obſerving the ſame Cape, he finds that it bears N N W; I demand how faſt that Current ſets, and how farre he hath ſailed?*

As let a ſhip ſail from *A* towards B ſouth 30 miles, but by means of the Current, ſhe is driven more Eaſterly, namely to D, from whence ſetting the Cape *A*, it is found to bear *N N W.* And ſeeing the Current ſets from *B* towards *D* Eaſterly; therefore the angle of Reflection *B D A* is 6 points, that is, 67 deg. 30 min. Here then is demanded the diſtance *A D*, and the drift of the Current in that time *B D*.

| | | |
|---|---|---|
| As the ſine of the angle of Reflection | *s* B D A 67 d. 30 m. | .9344 |
| To the ſimple motion of the ſhip | A B 30 miles | 1.4771 |
| So the ſine of the angle of Deflection | *s* D A B 22 d. 30 m. | 9.5736 |
| To the motion of the Current | B D $12\frac{16}{100}$ | 1.0581 |

And further,

| | | |
|---|---|---|
| As the ſine of the angle of Reflection ſBDA 67d.30m. | | .0344 |
| To the diſtance run by the Log A B 30 miles, | | 1.4771 |
| So is Radius | | |
| To the compound motion of the ſhip A D, $32,\frac{47}{60}$ | | 1.5115 |

And thus we find that Current to ſet $12\frac{16}{60}$; that is, neer $12\frac{1}{6}$ miles in 6 hours, and the diſtance run to be $32\frac{1}{2}$ miles almoſt.

That the thing may be better conceived, we will uſe two or three Examples more familiar and obvious to every mans experience; yet grounded upon the ſame Principles and Reaſons.

8 *Admit that* Tulis-ſtairs *bear from* Billingſgate-ſtairs *S W Southerly, namely, South-weſterly* 40 *degrees, and be diſtant* 80 *Poles: and ſuppoſe the tide of Ebbe to run there Eaſtward* $2\frac{1}{2}$ *miles an hour, and that a pair of Oares, rowing* $4\frac{1}{2}$ *miles an hour, would go ſtraight over from the firſt to the ſecond: how ſhall they row over, namely, upon what degree or point of the Compaſſe, and how far ſhall they row to get thither, and in what time?*


Let A repreſent *Billingſ-gate-ſtairs*, D *Tulis-ſtairs*, A E the ſimple motion of the Boat, E D the motion of the Current, then is A the angle of Deflection, E the angle of Incidence; D the angle of Reflection 130 degr. or 50 degrees.

| | | |
|---|---|---|
| As the ſimple motion of the Boat | A E $4\frac{1}{2}$ miles | 9.34679 |
| Is to the motion of the tide | D E $2\frac{1}{2}$ miles | 0.39794 |
| So the ſine of Reflection | D ſ 50 deg. | 9.88425 |
| To the ſine of Deflection | A ſ 23 d.3 m. | 9.62898 |

Thus the poſition, from A to D, being ſouth-weſterly 40 deg.

deg. and the angle of Deflection A 23 deg. 3 min. the position from A towards E, is South-westerly 63 degr. 3 min. that is, W S VV southerly. And so must those Oares row to go straight over.

*Secondly, for the distance* A E.

| | | |
|---|---|---|
| From the angle of Reflection | D | 50 deg. 00 min. |
| Substract the angle of Deflection | A | 23 deg. 03 min. |
| And there rests the angle of Incidence | E | 26 deg. 57 min. |

| | | |
|---|---|---|
| As the sine of Incidence | *s* E 26 d. 57 m. | 0.34370 |
| Is to the true distance | A D 80 poles | 1.90309 |
| So the sine of Reflection | *s* D 50 deg. 0 mim. | 9.88425 |
| To the simple motion | A E 135 $\frac{3}{10}$ poles | 2.13104 |

Lastly, for the time, seeing 320 Poles make a mile, and they row $4\frac{1}{2}$ miles in an hour, it is 1440 Poles in an hour: so the proportion is,

| | | |
|---|---|---|
| As the simple hourly motion | 1440 | 6.8416 |
| To the simple motion before found | 135 $\frac{3}{10}$ | 2.1310 |
| So is an hour in minutes, namely, | 60 min. | 1.7781 |
| To the time required in minutes | 5 $1\frac{63}{100}$ | 0.7507 |

And so long will they be rowing.

*9 But suppose they will row harder, to go a shorter cuit; namely, to go South-west by West, how fast must they row to go straight over, and how far, and in what time?*

Then seeing the Position from A to D is South-westerly 40 deg. and S W by W is South-westerly 56 deg. 15 min. therefore the angle of Deflection at A is 16 deg. 15 min. the angle of Reflection D, as before, 50 deg. 0 min. the angle of Incidence E is 33 deg. 45 min.

| | | |
|---|---|---|
| As the sine of deflection | *s* A 16 deg. 15 min. | .55311 |
| To the motion of the tide D E | $2\frac{1}{2}$ miles | 0.39794 |
| So the sine of the angle of Reflection D | 50 deg. 0 m. | 9.88425 |
| To the simple hourly motion of the Boat A E | 6, $\frac{844}{1000}$ | 0.83530 |

And such is the hourly motion of the Boat, namely, 6 $\frac{844}{1000}$ miles In an hour.

*Second-*

And further,

| | | |
|---|---|---|
| As the ſine of the angle of Reflection ſBDA 67d.30m. | | .0344 |
| To the diſtance run by the Log A B 30 miles, | | 1.4771 |
| So is Radius | | |
| To the compound motion of the ſhip A D, 32,$\frac{47}{100}$ | | 1.5115 |

And thus we find that Current to ſet $12\frac{16}{100}$; that is, neer $12\frac{1}{6}$ miles in 6 hours, and the diſtance run to be $32\frac{1}{2}$ miles almoſt.

That the thing may be better conceived, we will uſe two or three Examples more familiar and obvious to every mans experience; yet grounded upon the ſame Principles and Reaſons.

8 *Admit that* Tulis-ſtairs *bear from* Billingſgate-ſtairs *S W Southerly, namely, South-weſterly* 40 *degrees, and be diſtant* 80 *Poles: and ſuppoſe the tide of Ebbe to run there Eaſtward* $2\frac{1}{2}$ *miles an hour, and that a pair of Oares, rowing* $4\frac{1}{2}$ *miles an hour, would go ſtraight over from the firſt to the ſecond: how ſhall they row over, namely, upon what degree or point of the Compaſſe, and how far ſhall they row to get thither, and in what time?*


Let A repreſent *Billingſ-gate-ſtairs*, D *Tulis-ſtairs*, A E the ſimple motion of the Boat, E D the motion of the Current, then is A the angle of Deflection, E the angle of Incidence; D the angle of Reflection 130 degr. or 50 degrees.

| | | |
|---|---|---|
| As the ſimple motion of the Boat | A E $4\frac{1}{2}$ miles | 9.34679 |
| Is to the motion of the tide | D E $2\frac{1}{2}$ miles | 0.39794 |
| So the ſine of Reflection | D ſ 50 deg. | 9.88425 |
| To the ſine of Deflection | A ſ 23 d.3 m. | 9.62898 |

Thus the poſition, from A to D, being ſouth-weſterly 40 deg.

deg. and the angle of Deflection A 23 deg. 3 min. the position from A towards E, is South-westerly 63 degr. 3 min. that is, W S VV southerly. And so must those Oares row to go straight over.

*Secondly, for the distance* A E.

| | | |
|---|---|---|
| From the angle of Reflection | D | 50 deg. 00 min. |
| Substract the angle of Deflection | A | 23 deg. 03 min. |
| And there rests the angle of Incidence | E | 26 deg. 57 min. |

| | | |
|---|---|---|
| As the sine of Incidence | *s* E 26 d. 57 m. | 0.34370 |
| Is to the true distance | A D 80 poles | 1.90309 |
| So the sine of Reflection | *s* D 50 deg. 0 mim. | 9.88425 |
| To the simple motion | A E 135 $\frac{2}{10}$ poles | 2.13104 |

Lastly, for the time, seeing 320 Poles make a mile, and they row 4$\frac{1}{2}$ miles in an hour, it is 1440 Poles in an hour: so the proportion is,

| | | |
|---|---|---|
| As the simple hourly motion | 1440 | 6.8416 |
| To the simple motion before found | 135 $\frac{2}{10}$ | 2.1310 |
| So is an hour in minutes, namely, | 60 min. | 1.7781 |
| To the time required in minutes | 5 $1\frac{61}{100}$ | 0.7507 |

And so long will they be rowing.

9 *But suppose they will row harder, to go a shorter cutt; namely, to go South-west by West, how fast must they row to go straight over, and how far, and in what time?*

Then seeing the Position from A to D is South-westerly 40 deg. and S W by W is South-westerly 56 deg. 15 min. therefore the angle of Deflection at A is 16 deg. 15 min. the angle of Reflection D, as before, 50 deg. 0 min. the angle of Incidence E is 33 deg. 45 min.

| | | |
|---|---|---|
| As the sine of deflection | *s* A 16 deg. 15 min. | .55311 |
| To the motion of the tide D E | 2 $\frac{1}{2}$ miles | 0.39794 |
| So the sine of the angle of Reflection D | 50 deg. 0 m. | 9.88425 |
| To the simple hourly motion of the Boat A E | 6 $1\frac{344}{1000}$ | 0.83530 |

And such is the hourly motion of the Boat, namely, 6 $1\frac{344}{1000}$ miles in an hour.

*Second-*

*Secondly, for the simple Motion.*

| | | |
|---|---|---|
| As the sine of Incidence | *s* E 33 d. 45 m. | 0.25526 |
| Is to the true distance | A D 80 poles | 1.90309 |
| So the sine of Reflection | *s* D 50 deg. 0 mim. | 9.88425 |
| To the simple motion | A E 100 $\frac{3}{10}$ poles | 2.04260 |

Thus it appears they must row 110 $\frac{3}{10}$ poles to get over.

*Lastly, for the time.*

The hourly motion before-found 6 $\frac{344}{1000}$ reduced into Poles, is 2190 $\frac{1}{10}$.

| | | |
|---|---|---|
| As the simple hourly motion | 2190 | 6.65956 |
| Is in proportion to an hour, or | 60 min. | 1.77815 |
| So is the simple motion before-found | 110 $\frac{3}{10}$ | 2.04260 |
| To the time required | 3 $\frac{022}{1000}$ min. | 0.48031 |

And so long will they be rowing over.

10 *But admit a Sculler rowing three miles an hour, would cross straight over at the same time, upon what point must he row, and how far to get thither, and in what time will he do it?*

*First, for the angle of Position.*

| | | |
|---|---|---|
| As the hourly motion of the Boat | A E 3 miles | 9.52288 |
| To the sine of Reflection | D *s* 50 deg. | 9.88425 |
| So is the hourly motion of the stream | D E 2 $\frac{1}{2}$ miles | 0.39794 |
| To the sine of Deflection | A *s* 39 d. 40 m. | 9.80507 |

Now seeing the position from *Billingsgate* to *Tulis-stairs*, namely from A to D, is by supposition to the VVestwards of the South 40 deg. and the angle of Deflection *A* is here found to be 39 deg. 40 min. therefore the position from *A* to *E* is from the South to the Westwards 79 deg. 40', which is West and by South, and almost 1 deg. Westerly, and so must that *Sculler* row to go straight over. *Secondly, for the distance* A E.

| | | |
|---|---|---|
| From the angle of Reflection | D | 50 deg 00 min. |
| Substract the angle of Deflection | A | 39 deg. 40 min. |
| And there rests the angle of Incidence | E | 10 deg. 20 min. |

| | | |
|---|---|---|
| As the sine of Incidence | *s* E 10 deg. 20 min. | .74624 |
| To the true distance | A D 80 poles | 1.90309 |
| So is the sine of Reflection | *s* D 50 deg. 0 min. | 9.88425 |
| To the simple motion | *A E* 341 $\frac{6}{10}$ | 2.53358 |

And

And thus it appears, that though the distance of the two places be but 80 Poles, yet if according to the question, he row but after three miles an hour, and the stream set after 2 ½ miles an hour, then he must row 341 $\frac{6}{10}$ poles to go straight over.

*Lastly, for the time.*

Three miles is 960 Poles, say then

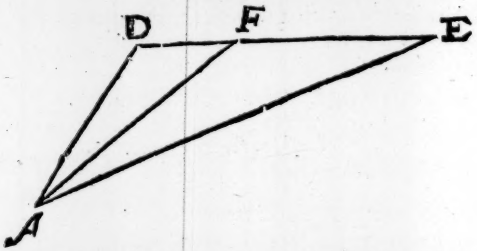
| | | |
|---|---|---|
| As the simple hourly motion | 960 | 7.01773 |
| To the simple motion before found | 341 $\frac{6}{10}$ | 2.53358 |
| So is an hour in minutes, namely, | 60 min. | 1.77815 |
| To the time required in minutes | 21 $\frac{35}{100}$ | 1.32946 |

And thus it appears that the time requisite to row over, rowing 3 miles an hour, is 21 $\frac{35}{100}$ minutes, whereas we found before, that rowing there 4 ½ miles an hour, they might row over in 5 $\frac{63}{100}$ minutes, which is little more then a fourth part of the time.

There might be other and that great variety of Questions of this nature proposed and resolved, many of good use in practise, which the Water-men by daily experience without other Rules, are able to guesse at something neerly, sufficing for their occasions: my intent in these especially to explicate the Compound motion of a Ship, or other Vessel sailing or rowing where there is a Current; which by such familiar Examples may seem more evident. I cannot insist upon them by reason of mine other occasions, nor spend that time in these here handled, which else I should have done; whence if any defect or mistake should arise, if the Reader be pleased to give me friendly notice of it, I shall as thankfully accept it, and reform it: We propose next a question at Sea, which let be this.

11 *There is a Current at Sea setting East 12 miles in 24 hours a ship sails in the same from a certain Port West-South-west 6 dayes, and then returning thence, and sailing N E by North 3 dayes, falls with the Port from whence he first departed, I demand what his dead Reckoning was outwards, and what back again, and how far these two Ports were asunder, and upon what point of the Compasse?*

Ans




As let the Current ſet from E towards D, and let the firſt Port be A, the ſecond F, and let the Courſe outward bound be repreſented by A E, and the Courſe homewards by D A, &c.

And foraſmuch as D E is an Eaſt and weſt line, and A E weſt-ſouthweſt, therefore the angle at E is 22 deg. 30 m. and by the like reaſon, the angle at D is 123 deg. 45 min, or 56 deg. 15 m. and the angle at A 33 deg. 45 min. and E D being the ſetting of the Current for 9 dayes, is 108 miles.

*Firſt then, for the dead Reckoning outward, namely* A E.

| | | |
|---|---|---|
| As the ſine of the angle at A | ſ 33 deg. 45 min. | .25526 |
| To the line D E | 108 miles | 2.03342 |
| So is the ſine of the angle at D | ſ 56 deg. 15 m. | 9.91985 |
| To the line A E | 161 $\frac{6}{10}$ | 2.20833 |

Thus A E his dead Reckoning outwards is 161 $\frac{6}{10}$.

*Secondly, for* A D.

| | | |
|---|---|---|
| As the ſine of the angle D A E | ſ 33 deg. 45 min. | .25526 |
| Is to the line D E | 108 miles | 2.03342 |
| So is the ſine of the angle D E A | ſ 22 deg. 30 min. | 9.58184 |
| To the line A D | 74 $\frac{4}{10}$ miles | 1.87152 |

VVhich 74 $\frac{4}{10}$ miles is his dead Reckoning homewards.

*Thirdly, for the angle* D A F, *or* D F A

| | |
|---|---|
| To the ſide A D is found | 74 $\frac{4}{10}$ miles. |
| The ſide D F for 3 dayes, is | 36 miles. |
| The ſumme of both is | 110 $\frac{4}{10}$ |
| Their Difference is | 38 $\frac{4}{10}$ |
| The ſumme of the angles D A F and D F A | 56 deg. 15 m. |
| The half ſumme is | 28 deg. 7 $\frac{1}{2}$ m. |

*The*

*The Proportion.*

| | | |
|---|---|---|
| As the ſumme of the ſides | 110 $\frac{4}{10}$ | 7.95703 |
| Is to their difference | 38 $\frac{4}{10}$ | 1.58433 |
| So is the tangent of | 28 deg. 07 min. $\frac{1}{2}$ | 9.67279 |
| To the tangent of | 10 deg. 32 min. | 9.26932 |

Which added together, make the angle D F A 38 deg. 39 m. and an half.

And ſeeing the Rumb from F to D is Eaſt, and the angle D F A 38 deg. 39 min. and an half: therefore the Rumb from F to A is to the Northwards of the Eaſt 38 deg. 39 min. and an half; that is, N E by Eaſt almoſt half a point Northerly, which is the Rumb from the ſecond Port to the firſt.

*Laſtly, For A F the Diſtance of theſe two Ports.*

| | | |
|---|---|---|
| As the ſine of the angle D F A | 38 deg. 39 min. $\frac{1}{2}$ | .20434 |
| To the dead Reckoning homewards AD | 74 $\frac{4}{10}$ miles | 1.87152 |
| So is the ſide of the angle D | 56 deg. 15 min. | 9.91985 |
| To the diſtance A F | 99 $\frac{02}{100}$ miles | 1.99571 |

Thus the true diſtance of thoſe two Ports is 99 miles, and ſomewhat more.

Sundry other Queſtions of like nature might be propoſed, which to him that well underſtandeth theſe will not be difficult.

Theſe Principles a little inlarged may further with a few Experiments be applyed in the diſcovery of ſome myſteries in compound motions not yet divulged; though much indeavoured by ſundry famous men in ſeveral parts of *Europe*, but theſe we ſhall not touch at preſent.

12 *To find where there is a Current at Sea, alſo which way it ſets, and how faſt.*

THis may be done by comparing the reckoning outwards with the reckoning homewards, whereof we will give an Example or two.

Firſt, admit a ſhip ſail from a certain Port, by one or ſeveral Rumbs or Diſtances, till ſhe arrive at a ſecond, and there finde reckoning by Courſe and Diſtance, that ſhe is more Southerly than the Port from which ſhe departed by 541 miles, and more Weſterly by 145 miles: But by his Reckoning homewards,

when he arrives again at the first place, he finds himself to the Northwards of the second 541 miles, as before, and to the Eastwards 305 miles. Now supposing he were three dayes outwards bound, and five dayes homewards bound, I would know which way the Current sets, and how fast? Here because the Easterly distance homewards is greater then the westerly distance outwards; therefore from the Easterly distance 305 miles, substract the westerly distance 145 miles, the remainer being 160 miles, is the motion of the Current to the VVestwards.

And thus it appears, that that Current sets to the westwards, 160 miles in eight dayes, that is, 20 miles a day, or $\frac{1}{3}$ of a mile every hour.

2 *Example.* Admit a ship sail from the *Summer-Islands*, by several Rumbs and distances, till she arrive at Cape *Codd* in *New-England*, namely, from the East part of the *Summer-Islands* (the Variation being allowed) first, North 20 miles, and then N N VV 150 miles, the second day N by VV 180 miles: the

| | *North* | *South* | *East.* | *West.* |
|---|---|---|---|---|
| North 20 miles | 20 0 | | | |
| North N VV. 150 miles | 138 6 | — — | — — | 57 4 |
| North by VV 180 miles | 176 5 | — — | — — | 35 1 |
| North 90 miles | 90 0 | | | |
| North-east 88 miles | 62 2 | — — | 62 2 | |
| 528 miles | 487 3 | | 62 2 | 92 5 |
| | | | | 62 2 |
| | | | | 30 3 |

third day North 90 miles; the fourth day N East 88 miles, and so arrive at Cape *Codd*: then by these Courses and Distances we may gather by the foregoing Table, that Cape *Codd* should by this Reckoning be to the Northwards 487 miles: and to the VVestwards 30 miles, as here appears.

Now suppose she sail back again from Cape *Codd* towards the *Summer-Islands*, the first day S S VV 150 miles; the second day S S VV 160 miles; the third day S by VV 130 miles; the fourth day South 140 miles; the fifth day East 110 miles, and so becomeagain to the East part of the *Summer-Islands*.

North

| | North | South | East | West. |
|---|---|---|---|---|
| South S W 150 miles | —— | —— | —— | —— |
| South S W 160 miles | —— | 1386 | —— | 57 4 |
| South by W 130 miles | —— | 1478 | —— | 61 3 |
| South 140 miles | —— | 1275 | —— | 25 3 |
| East 110 miles | —— | 1400 | 110 0 | |
| 690 miles | | 5540 | 110 0 | 144 0 |
| | | | | 110 0 |
| | | | | 34 0 |

These Courses and Distances make as here appeareth the *Summer-Islands* to be to the southwards of Cape *Codd* 554 miles, and to the Westwards 30 miles.

Therefore by this last Reckoning back again Cape *Codd* should be to the Northwards of the *Summer-Islands* 554 miles, and to the Eastwards 34 miles, whereas by the former reckoning outwards, it was to the Northwards onely 487 miles, and to the Westwards 30 miles; so that the Difference of these two reckonings outwards and back again is 67 miles Northerly, and 64 miles Easterly, which sheweth that the Current in that time, namely, in 9 dayes, hath set to the Northwards 67 miles, and to the Eastwards 64 miles; that is, North-east little Northerly 93 miles, as by the fore-going Table doth appear, which is 10 $\frac{1}{3}$ miles every day.

And what we have here done by the Tables might have been done (as the fore-going Problemes) by the Doctrine of plain triangles.

*FINIS.*